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A HANDBOOK
OF
SURGICAL PATHOLOGY.

A HANDBOOK
OF
SURGICAL PATHOLOGY,

FOR THE USE OF STUDENTS

IN THE

Museum of St. Bartholomew's Hospital.

BY

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HOSPITAL; SURGEON TO THE METROPOLITAN FREE HOSPITAL, AND
ROYAL HOSPITAL FOR DISEASES OF THE CHEST, CITY ROAD.**



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PREFACE.

THIS work is designed to aid the student in the acquirement of the practical knowledge of pathology now required by the surgical examining boards of this country.

A conversation with Mr. Savory upon the want of a work which would make the Museum more useful to the student suggested the idea of the present undertaking.

My plan is to give a short general account of the several surgical affections, and then to illustrate the morbid appearances, the various stages, the terminations, and, when possible, the causes and the results of treatment of these affections, by specimens selected from the museum.

The method of conducting the pathological part of the examinations at the Royal College of Surgeons of England is to show the candidate a number of specimens of surgical affections, the morbid appearances of which he is expected to recognize, to account for, and to describe. This book encourages the method of study which the highest surgical authority recommends by the nature of its examinations.

As the work is intended for use in the museum, only those affections which are there represented by specimens have received attention.

Many of the specimens illustrate more than one pathological condition: hence the same specimen is often referred to under several heads; but, in such cases, only so much of it is described as bears upon the point under consideration.

The specimens are generally described in the words of the catalogue ; but as fresh descriptions have occasionally been written, or those of the catalogue variously altered, I hold myself responsible for the whole.

Many valuable specimens of tumours were placed in the museum at a time when the microscope was seldom used ; and are described in the catalogue without reference to their histological structure. Hence it was necessary to examine many microscopically before they could be of service in the present work. This I have done, by the kind permission of Mr. Morratt Baker, the curator of the Museum, and the results of the examinations, verified in many instances by my friend Dr. Goodhart, are stated at the end of the descriptions of the specimens. Sections of the tumours, with in many cases a drawing, have, with the permission of the curator, been placed in the Microscopical Cabinet.

To Mr. Morratt Baker I am indebted for much valuable advice in the preparation of this work. My thanks are also due to my friend, Mr. D. A. Gresswell, who has lent me most able assistance in seeing this work through the press, and whose careful reading has been the means of removing many literary inaccuracies which would otherwise have appeared.

A list of the authors whose works have been consulted is appended.

27, WEYMOUTH STREET,
PORTLAND PLACE, W. ;
August, 1878.

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CHAPTER I.

DISEASES OF BONE.

IN studying diseases of bone it should be borne in mind that bone, as we are accustomed to see it in the dry state, differs widely from bone as it exists during life. A living bone is composed of connective tissue impregnated with earthy salts; it is covered by a membrane—the periosteum, whilst its interior is lined by a similar membrane—the endosteum, and filled by a richly vascular adipose tissue—the medulla. Numerous blood-vessels proceeding from the periosteum and medulla traverse the Haversian canals, forming a complete vascular anastomosis through the bone, whilst a living cell (osteoblast) occupies each lacunar space, and is connected with adjacent cells by radiating processes which lie in the canaliculi. It should also be remembered that many bones do not acquire their full proportions till adult life, and, further, that nutritive changes are actively proceeding even in the fully formed bone. The long bones attain their length by growth and ossification of the cartilage between their diaphysis and epiphyses, and their thickness by subperiosteal ossification, while simultaneously the central part of the originally solid bone becomes absorbed, and its place occupied by adipose tissue (the medulla).

Diseases of bone may be divided into the following classes :

1. Inflammation and its results.
2. Simple defect or increase in nutrition (atrophy and hypertrophy).
3. Changes dependent upon constitutional causes.
4. New growths.

1. INFLAMMATION AND ITS RESULTS.

Inflammation of bone, occurring as it does in the soft parts of bone, differs in no way from inflammation of soft structures, except that the presence of the hard earthy framework exercises some modifying influence upon the process, and leads to some peculiarities of appearance. Moreover, the results of inflam-

mation of bone are the same as those of inflammation of soft structures; caries and ulceration, and, again, necrosis and gangrene, may, in fact, be considered synonymous terms, but conventionally applied to different structures—caries and necrosis to bone, ulceration and gangrene to soft parts.

Inflammation of bone is spoken of as Periostitis, Osteo-myelitis, or Ostitis, according as it affects the periosteum, the medulla, or the bone respectively, but, although it may be limited primarily to one of these structures, it sooner or later affects all three; so that in many specimens it is impossible to say which was the first to be affected, or whether the inflammation should be considered periostitis, osteo-myelitis, or ostitis.

The varieties of inflammation of bone may now be considered in succession.

PERIOSTITIS.

Periostitis may be acute or chronic.

ACUTE PERIOSTITIS.

Acute periostitis is an affection nearly always confined to early life; it is usually the result of a slight injury, as a blow or fall, in a strumous or otherwise debilitated subject; it generally attacks the shafts of the long bones, more especially the tibia and femur. In the early stages of the disease, the periosteum appears red and injected, and somewhat gelatinous, in consequence of commencing cell-infiltration, occasionally white and gangrenous. As the disease advances the inflammation spreads to the bone and even to the medulla; suppuration rapidly ensues, and pus, often in considerable quantities, is formed beneath the periosteum. If the pus is not let out by a timely incision, it quickly spreads far and wide, stripping off the periosteum from the bone, and leaving the latter, thus cut off from its nutritive supply, bare and dead. In this manner large portions, or even the whole of the shaft, with the exception generally of the epiphyses, may perish.

When the disease is very rapid in its course the periosteum is occasionally found separated even before pus has had time to form, in which case a small quantity of turbid, blood-stained fluid is commonly found between it and the bone.

Acute periostitis is generally limited to the diaphyses of long bones; the epiphyses are seldom attacked, since they have a separate set of vessels, which, so long as the epiphysal cartilages remain unossified, do not communicate with those of the diaphysis. Exceptions to this rule do, however, occur. The neighbouring joints are

occasionally involved in the disease, as their capsules are genetically continuous with the periosteum. Acute periostitis frequently terminates in pyæmia, abscesses in the heart and pericardium being exceedingly common in pyæmia from this cause.

The manner in which the dead bone is separated, and the shaft restored by the formation of new bone, will be found described under necrosis.

Acute periostitis, with death of the whole diaphysis; the epiphyses not affected.

I. 258.—Acute periostitis of the clavicle following a fall upon the shoulder. The whole length of the bone with the exception of the acromial and sternal ends died, and was found, as now seen, in a cavity formed by the separated periosteum and surrounding soft parts. The cavity in the recent state was filled with bloody pus. The patient was a delicate boy, aged five years. Several days after the fall on the shoulder, already referred to, he complained of severe pain in and about the clavicle. The parts were swollen, and so painful that a complete examination could not be made. It was treated as a fracture, but in a few days severe inflammation of the pericardium, heart, and pleuræ (pyæmia) followed, and the child died eleven days after receiving the injury.

I. 366.—A femur from which the periosteum of the shaft had been completely separated by a large collection of pus, from a child two and a half years old. The child had received a slight injury four days before admission. Death occurred from pyæmia. The heart is contained in xii, 127.

Acute periostitis, with death of a portion of the diaphysis.

I. 199.—Section of a boy's tibia in which there is necrosis of the middle half of the shaft, with detachment of the periosteum and adjacent soft parts from the whole circumference of the dead portion. The necrosis was consequent upon acute inflammation of the periosteum.

I. 326.—The tibia of a boy, aged eight years. The upper portion of the shaft is dead, whilst new bone extends for some distance from the lower epiphysis upon the dead portion. The patient received an injury to the leg a few weeks before death. He died of acute pericarditis (pyæmia).

Acute periostitis, with death of the whole diaphysis and epiphyses.

There is no specimen of acute periostitis spreading to the epiphyses in the museum. Such a condition is very rare.

CHRONIC PERIOSTITIS.

Chronic periostitis is almost always associated with inflammation of the adjacent bone, but, unlike the acute, is seldom accom-

panied by severe constitutional symptoms and death of large portions of bone. It is generally the result of an injury to the bone or periosteum, or of syphilis, scrofula, or rheumatism, and is generally limited in extent, constituting what is commonly called a node.

The periosteum, after presenting some increase of vascularity, which is, however, much less than in acute periostitis, gradually becomes thickened, gelatinous, and fatty looking, in consequence of cell-infiltration, and can be more readily stripped off the adjacent bone than in health.

The superficial layers of the bone beneath the thickened periosteum are also usually infiltrated with inflammatory products. When the inflammation has reached this stage it may terminate in resolution, or the inflammatory material both in the periosteum and in the substance of the bone may undergo ossification, leading to the permanent thickening of the bone, or, as is less commonly the case, break down into pus, leading to ulceration or necrosis of the bone beneath. The ossifying variety, or the hard node as it is called when limited in extent, is more common in the bones of the lower extremities; the suppurating, or the soft node, in the cranium.

OSSIFYING VARIETY OF PERIOSTITIS.

I. 53.—Section of a tibia exhibiting the effects of chronic periostitis. The periosteum is greatly thickened, and beneath it is an irregular deposit of bone derived partly from subperiosteal ossification and partly from ossification of inflammatory matter in the circumferential Haversian canals.

Sub-series A. 19.—Other half of above specimen (dry).

The new bone formed under the periosteum presents various appearances. It may be produced in—

Smooth uniform layers.

Sub-series A. 2.

Thin spongy layers.

Sub-series A. 5, 9, 11.

Stalactitic plates and masses.

I. 144, 201, 375. Sub-series A. 14.

Node-like masses.

Sub-series A. 13.—Sections of tibia with nodes on its anterior surface. The sections of the nodes show that the new bone was produced in great part on the surface of the old shaft, indicating that the inflammation was limited in great extent to the periosteum, a condition but rarely met with except in syphilis.

Sub-series A. 8.—A typical specimen of a *syphilitic* node on the internal surface of the tibia.

Sub-series A. 20.—A similar specimen.

Sub-series A. 23.—Sections of a tibia exhibiting a circumscribed thickening and induration of its anterior wall, the result of periostitis following the irritation of a chronic ulcer of the soft parts covering it.

These nodes produced by *chronic ulcers* must be distinguished from those resulting from syphilis, which at first sight they somewhat resemble. In both there is a circumscribed formation of new bone, but in the former the new bone is sharply defined, with elevated edges, in the latter it is imperceptibly bevelled off into the old shaft; in the former the surface is flattened, in the latter it is rounded; in the former it is irregular, rough, and coral-like, in the latter smooth, compact, and reticulated.

It frequently happens that a cutaneous ulcer, though primarily leading to periostitis and the formation of new bone, may by extension cause the ulceration of the same.

Sub-series A. 52.—Portion of a tibia. An ulcer of the integuments produced periostitis which gave rise to new bone in consequence of irritation; the ulceration afterwards extended to the new bone.

Sub-series A. 50.—See this specimen also.

SUPPURATIVE VARIETY.

In the bones of the cranium.

Periostitis of the cranial bones is nearly always of syphilitic origin. It generally leads to ulceration and necrosis of the bone beneath.

Sub-series A. 110, 117, and many other specimens in this series, exhibit necrosis of the skull following suppurative periostitis.

In the bones of the extremities.

Suppurative periostitis in the bones of the extremities is rare; when it occurs, it is accompanied by ulceration rather than by necrosis of the adjacent bone. Around the ulcerated portion the periostitis generally assumes the ossifying form, hence new bone is generally deposited upon the surface of the shaft above and below the ulcerated spot. This condition is analogous to the ulcer with callous edges of soft parts.

I. 172.—Portion of a tibia in which a large piece of the middle of the shaft has been destroyed by ulceration extending through it. The remaining bone exhibits the effects of inflammation, being light, brittle, and porous, and there is a sub-periosteal deposit of new bone upon its surface above and below the diseased part.

The ulceration was the result of periostitis consequent upon external injury from a rope coiled round the leg.

OSTEO-MYELITIS.

The term osteo-myelitis is applied to inflammation and suppuration in the medulla and cancellous tissue of bone. Osteo-myelitis is almost invariably caused by some injury to the interior of a bone; thus, it most commonly occurs in the medulla of long bones after compound fracture or surgical operations, such as amputations and resections; or in the diploë of the skull-cap after scalp wounds or blows upon the head. The disease is generally acute and widely diffused, the inflammation rapidly involves the whole medulla, and from thence spreads through the cancellous and compact tissue to the periosteum; the large patulous veins of the medulla become filled with purulent thrombi, and the patient usually dies of pyæmia in a few days. Abscesses in the heart and pericardium are more frequent in pyæmia from this than in pyæmia from any other cause. In other instances the inflammation is less acute and more circumscribed, pyæmia does not occur, and the patient recovers.

At first the bone-substance itself is unaffected, but after the inflammation has reached the periosteum and suppuration has taken place the whole or greater portion undergoes necrosis. On section in the early stage the medulla, and to a less extent the cancellous tissue, appear intensely red and injected, and sprinkled here and there with numerous small ecchymoses. Later on, collections of pus are seen scattered over the section, the yellow colour of which strongly contrasts with the vivid redness of intervening portions. Still later, the periosteum is found separated, the medullary membrane thickened, and a large portion of bone white and dead. In less acute cases, only the bone lamellæ immediately surrounding the medulla die (central necrosis or caries).

DIFFUSE OSTEO-MYELITIS.

In long bones.

I. 47.—Sections of the head, neck, and shaft of a femur exhibiting the earlier stages of osteo-myelitis. The bone substance itself is unaffected, but the medulla is intensely injected and pus has been formed in places. The osteo-myelitis followed amputation of the thigh.

I. 195.—Section of a tibia from a boy aged eighteen. The medulla is intensely inflamed, and inflammatory exudation and pus are abundantly deposited in the cancellous tissue throughout the whole bone. Suppuration has also occurred between the epiphyses and shaft, and irregular ulceration extends through the articular cartilages into the knee- and ankle-joints. (See II. 46.) The periosteum is separated from the shaft in nearly its whole extent, and is very vascular, thick, puffy, and velvet-

like on its inner surface; the whole shaft of the bone is in a state of necrosis.

I. 50.—A section of a tibia, exhibiting the effects of osteo-myelitis. The inflammation has extended to the periosteum. Upon the external surface of the bone, in some situations, there is ulceration; in others, there are irregular deposits of osseous matter; and some small portions of its walls have suffered necrosis.

I. 207.—Portions of the humerus, radius, and ulna. The sections of the humerus exhibit thickening of the medullary membrane, the result of osteo-myelitis. The membrane is in some places upwards of a line in thickness and presents an uneven velvet-like surface. A portion of the lamellæ surrounding the medullary canal has necrosed and lies loose in this cavity. A piece of glass is passed through a long fistulous passage leading from the medullary cavity through the lower end of the humerus into the elbow-joint. The greater part of the articular cartilage is removed from the ends of the bones forming the elbow-joint, and the remaining synovial membrane is thickened.

In short bones.

I. 104.—Portions of the tarsus. Diffuse osteo-myelitis has occurred in the cancellous structure of the os calcis, and the whole of the internal cancellous texture of the bone has perished, and was in process of separation from the thin osseous layer constituting its walls.

CIRCUMSCRIBED OSTEO-MYELITIS.

In stumps after amputation.

I. 211.—Sections from the extremity of a stump after amputation above the knee.

In this specimen, as is frequently the case when osteo-myelitis attacks a stump, the inflammation has been in great part limited to the bone which immediately surrounds the medullary membrane. At the extremity of the stump the inflammation has involved the whole circumference of the sawn end of the bone, from which the periosteum has receded, leaving nearly an inch of bone protruding beyond the soft parts. The protruded portion, and that immediately adjacent to it, is dead and in process of separation. As the osteo-myelitis spread up the medullary cavity it became less diffuse, and involved less and less of the surrounding bone, so that more of the interior than of the exterior of the shaft perished, giving to the sequestrum a conical appearance. This is well illustrated on the surface of the sections where the line of separation between the dead and the living bone is marked by an arched layer of granulations. A mass of soft spongy new bone, surrounding the old shaft above the necrosed portion, is formed, as seen in the specimen, between the receded periosteum and the surface of the living

bone. In an earlier stage a fungating reddish mass of granulations is generally seen projecting through the ring of necrosed bone from the inflamed medullary cavity. This, with the recession of the periosteum, is pathognomonic of osteo-myelitis.

I. 142.—Section of a femur from a stump, exhibiting an irregular osseous deposit on its surface, immediately above its extremity which has perished.

I. 155.—Portion of a femur from a stump. Both this and the preceding specimen exhibit, in a dry condition, the appearances described in I. 211. See also I. 81.

I. 158.—A sequestrum from a stump. Its conical shape is well seen, and was produced as described in I. 211. See also I. 164, and I. 328.

OSTITIS.

Ostitis, or inflammation of the bone itself, is always associated with some amount of inflammation of the periosteum and medullary membrane; it is therefore difficult in many cases to determine whether a given specimen should be considered as one of ostitis, periostitis, or osteo-myelitis, a point of some pathological interest, but fortunately of no practical importance. Ostitis may occur in any bone; it is most frequently met with, however, in the ends of the long bones, in the bones of the tarsus and carpus, in the bodies of the vertebræ, in the skull, and in the shafts of the bones of the lower extremities, especially the femur and tibia. It is generally the result of scrofula, syphilis, or rheumatism, but it may occur without any very evident predisposing cause. Ostitis in the ends of the long bones and in the bodies of the vertebræ will be more particularly referred to under "diseases of the joints" and "diseases of the spine." Ostitis may conveniently be divided into three stages:—1st. Increased vascularity. 2nd. Rarefaction. 3rd. Sclerosis—each corresponding to a similar stage of inflammation of soft parts.

1st Stage. Increased vascularity.

The blood-vessels in the Haversian canals and cancelli become dilated and distended with blood, as in the initiatory stage of inflammation of soft parts, and the vascular derangement rapidly extends to the vessels of the periosteum and medulla. The periosteum appears red and injected, and more readily separable from the bone than in health. On removing the periosteum, the surface of the bone appears suffused with a pinkish blush, markedly contrasting with the whiteness of the surrounding healthy bone. Scattered over the pink surface are numerous bloody points, due

to the rupture of the enlarged blood-vessels that run from the periosteum into the Haversian canals.

On section the bone appears full of blood, and of a bright red colour, with here and there a patch of yellow from commencing inflammatory infiltration. The medulla, like the periosteum, is slightly red and injected.

Appearance of the surface of the bone after removal of the periosteum.

I. 1.—Portion of a tibia. The periosteum has been reflected, and is very vascular. The surface of the bone is of a pink colour and dotted with points of red, showing the injection of the enlarged blood-vessels. The inflammation was the result of an abscess in the medulla.

Appearance on section.

I. 14.—Section of a tibia of a dog, in which necrosis was produced in a portion of the middle of the shaft. The bone above and below the necrosed part is inflamed. It appears highly vascular, and of a bright red colour.

I. 11.—A similar specimen. See also I. 48.

2nd Stage. Rarefaction.

In the second stage, comparable with that of exudation in soft parts, the connective tissue, enveloping the blood-vessels in the Haversian canals and cancelli, becomes infiltrated with inflammatory material, probably in great part derived from the escape of white blood-cells and from the exudation of liquor sanguinis from the dilated vessels. The earthy salts are loosened from their connection with the animal matter, and the bone lamellæ and trabeculæ are softened, eaten into as it were, and in part absorbed by the pressure of the inflammatory material, so that the Haversian canals and cancellous spaces appear preternaturally dilated and expanded, the compact bone being thus converted into cancellous and the cancellous widened out. Some authors maintain that the bone-corpuscles themselves take part in this rarefying process, whilst others believe that they remain entirely passive and are simply destroyed, along with the lacunæ in which they are contained, by the pressure of the inflammatory material.

The periosteum and adjacent soft parts are generally thickened and infiltrated with inflammatory products. The bone itself is lighter and softer than natural, and usually increased in size, and in the dry specimen rough, porous, and "worm-eaten" on the surface.

On section it presents a mottled reddish-yellow appearance from the presence of the inflammatory material in the cancelli; the walls

of the shaft in the case of the long bones are increased in thickness, and instead of presenting their ordinary compact structure, appear cancellous, apparently from the separation and widening out of the bone lamellæ. The medullary membrane, like the periosteum, is usually thickened and infiltrated. In macerated specimens the whole bone appears light, spongy, and cancellous in texture.

When a whole bone, as the tibia, is inflamed, it may become increased in length as well as in thickness. (Sub-series A. 46.)

I. 20.—Section of a tibia. Abundant inflammatory material is seen filling the cancellous tissue in the head of the bone.

I. 56.—Sections of the bones of an elbow-joint. Their whole texture is very light and brittle. From a boy in whom the inflammation had lasted several years.

I. 94.—Section of a femur. There has been an abscess in its cancellous tissue just above the condyles. The bone is expanded from pressure of inflammatory material for some distance beyond the seat of the abscess.

I. 138.—Portion of an os innominatum. The bone is increased in thickness from the expansion of its Haversian canals and cancelli. Its texture is very light and brittle.

I. 132.—Section of a femur, exhibiting the rarifying stage of osteitis around a portion of the shaft near the great trochanter which has undergone necrosis.

Sub-series A. 46.—A tibia and fibula. The tibia exhibits the rarifying stage of osteitis.

3rd Stage. Sclerosis.

This stage is comparable with that of induration and fibroid thickening of the soft parts. The inflammatory material filling the dilated cancelli and Haversian canals, together with that infiltrating the periosteum and medulla, becomes organized and undergoes ossification, so that the cancellous bone is converted into compact. Mr. Morrant Baker thinks that too much stress is laid upon the expansion of the compact bone and subsequent ossification of the inflammatory material in the expanded cancelli. He believes that the increased thickness of the wall of the shaft is due rather to formation of new bone, both by the periosteum and endosteum, than to expansion of the original shaft.

The whole bone is exceedingly hard and heavy. On removing the periosteum, which is always thickened, the surface of the bone is found covered by an irregular deposit of new osseous material. On section the walls of the shaft appear uniformly dense, compact, and greatly increased in thickness, the cancelli obliterated, and the medullary canal encroached upon or completely filled up by the new osseous material. The latter condition is very common in the ends of stumps after amputation. The Haversian canals are

smaller and fewer in number than natural. Although sclerosis, in conformity with the general usage, has been here described as a *stage* of osteitis, it would be more scientifically correct to regard it as a *termination*. For it must be remembered that after inflammatory exudation has taken place, although ossification is the most common result, other changes than this may occur, such as caries, necrosis, or suppuration and abscess, all of which might be as correctly designated stages of osteitis as sclerosis, but which with more propriety are always described as what they, accurately speaking, are—so many different terminations of the inflammatory process.

I. 51.—A section of a tibia. There has been necrosis of a portion of the outer wall and cancellous tissue. Immediately around the dead bone extensive ulceration has taken place, and around this the inflammatory material filling the cancelli has undergone ossification. Considerable quantities of inflammatory neoplasia have also been formed in the medulla, and in one situation this has been nearly consolidated into bone.

I. 74.—Sections of a tibia and fibula exhibiting ossification of the inflammatory material in the cancellous tissue. The osteitis was due to the irritation of a malignant ulcer penetrating the bone.

I. 75.—Section of a tibia. The walls are generally thickened and the cancellous tissue is consolidated by osseous deposits except in the part near the upper end of the bone. The disease had existed twenty-five years, having commenced in a severe laceration of the integuments, which never properly healed.

I. 196.—Sections of the humerus from a young person in whom there had been long-standing disease in and around the elbow-joint. A very thick layer of osseous substance has formed around the shaft to the borders of the articular surface; this osseous substance presents a vascular cancellous texture, and is surrounded by a layer of *compact* substance which is covered by the periosteum of the original bone. It is doubtful whether the new bone formed in this remarkable case was a deposit in the periosteum and on the surface of the shaft, or whether the disease consisted in the expansion of the walls of the bone by the gradual separation of the outer from the inner layers, and in the formation of cancellous bone between them.

The ulna and radius from the same joint presented a similar appearance; they are contained in I. 197 and 198.

I. 131.—Section of a tibia exhibiting various changes of structure consequent upon osteitis and osteo-myelitis. Ossification of the inflammatory new formation in the cancelli has taken place in some situations, while in others the osteitis has only reached the second stage. In other parts, again, suppuration has occurred.

Sub-series A. 1.—A femur, tibia, and fibula, exhibiting the rarifying stage of osteitis and the commencement of that of sclerosis.

Good specimens of sclerosis in the shafts of long bones are also seen

in Sub-series A. 2, 3, 4, 5, 12, 18, 22, and 24. In most of these it is difficult to say how much of the increase in thickness of the walls of the shaft is due to osteitis, and how much to periosteal and endosteal formations of new bone.

Sub-series A. 29.—Portions of a skull cap, exhibiting obliteration of many parts of the diploë, with irregular thickening and porosity of its tables, and deepening of the arterial grooves upon the internal table.

Sub-series A. 30, 31, 41, and 43.—Similar specimens.

Under the name of *osteitis deformans* Sir James Paget has called attention to a peculiar form of chronic inflammation of the bones. "The disease," he says, "affects most frequently the long bones of the lower extremities and the skull, and is usually symmetrical; the bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen. . . . The bones show the consequences of an inflammation, affecting in the skull the whole thickness, in the long bones chiefly the compact structure of their walls, and not only the walls of their shafts, but in a very characteristic manner those of their articular surfaces."

Sub-series A. 183.—Sections of the tibia and of the bones of the cranium, from the case upon which Sir James Paget's description of this form of osteitis is based. (See 'Med.-Chir. Trans.,' vol. lx.)

It is probable that many of the large porous skulls referred to above are specimens of a similar disease.

CARIES OR ULCERATION.

The term caries is here used as synonymous with ulceration of bone; by many, however, it is restricted to that form of caries here described as the strumous variety, which they look upon as a distinct disease.

Caries is the molecular death and disintegration of bone, a continuation, in fact, of the rarifying stage of osteitis, the thinned and eroded trabeculæ becoming in caries still further eroded, and finally broken down into small particles which escape with the inflammatory discharges or become absorbed. Its favourite seat is in the cancellous tissue; it may occur, however, though much less frequently, in the compact tissue.

Many points of resemblance exist between caries and ulceration of soft parts. "Each affection," says Professor Cooper, "is preceded by inflammation; each is attended with the formation of matter; each may be followed by the production of granulations; each may arise from local or constitutional causes; and each may be combined with the total extinction of vitality in certain points of the textures affected. Thus, precisely in the same way as we often see ulceration and sloughing exhibited together in the soft parts,

we also frequently find caries and necrosis prevailing together in the bones." Moreover, in caries of bone, as in ulceration of soft tissues, the parts around may be healthy, thickened, or in a state of softening. On contrasting caries with necrosis it will be seen that caries is molecular death of bone, necrosis death *en masse*; that caries generally affects the cancellous tissue, necrosis the compact; that caries is accompanied with but little, necrosis with extensive formation of new bone.

Caries may be divided into *simple* and *strumous*.

CARIES SIMPLEX, OR SIMPLE ULCERATION.

Simple ulceration may occur in any bone that has been the subject of inflammation. It is commonly met with, however, attacking the articular surface of the cancellous ends of bones after destructive inflammation of the joints; less frequently it occurs in the compact tissue of the shafts of the long bones after some forms of periostitis, and still more rarely in the lamellæ immediately surrounding the medullary canal after chronic osteo-myelitis.

Ulceration of syphilitic origin will be described under syphilis of bone.

Simple ulceration is characterised by its limited extent, by the indurated condition of the bone around, and by the tendency of the ulcerated surface to form granulations. Its appearances may be studied in detail as it occurs in the articular surfaces of bones after destructive joint disease, and in the compact tissue of the shafts of long bones after periostitis.

In the articular surfaces of cancellous bones.

Simple ulceration, when it attacks the articular surfaces, commonly sets in as soon as the cartilages are destroyed and the bared bone presents into the cavity of the joint. The process is as follows:—Whilst the cartilages are undergoing destruction the bone beneath becomes inflamed. The rarifying process, however, in the layers of bone next the cartilage does not pass into that of sclerosis, as described under osteitis, but is continued, the thinned and eroded bone trabeculæ becoming still further thinned and eroded until they are completely disintegrated and broken down, or so thinned that they are worn away by the friction of the contiguous articular surfaces upon each other. Whilst this destruction is taking place, the inflammatory material, which has been formed in less quantities in the bone below where the inflammation was less intense, becomes organized and ultimately undergoes ossification, thus limiting the extent of the ulceration. The manner in which granulations may

afterwards form, and by uniting with those of the contiguous articular surface, produce bony ankylosis, will be described under diseases of the joints.

The ulcerated surface appears sharply circumscribed, of a bright red colour, superficially excavated, and covered by small quantities of pus and minute particles of disintegrating bone. On section the bone immediately below the excavated surface appears simply rarified, infiltrated with inflammatory material, and slightly softened, but not oily and fatty-looking as in strumous caries. Still further from the surface the bone retains its natural hardness, or may be harder than natural from ossification of inflammatory material in the cancelli. New bone is also formed beneath the periosteum around the ulcerated articular end.

In the dry specimen the ulcerated surface appears superficially excavated and "worm-eaten," whilst the bone immediately below presents the ordinary characters of rarifying osteitis, and still lower those of sclerosis. The periosteal new bone generally assumes the form of stalactitic spicula, markedly differing from the flat nodular masses surrounding joints which have been the subjects of chronic rheumatic arthritis.

II. 4.—The bones of the ankle-joint. The cartilage has been removed in great part from the articular surfaces of the tibia, fibula, and astragalus, and the bone beneath is superficially ulcerated.

See also II. 2.

II. 23.—Bones of the wrist, exhibiting the effects of inflammation in the whole of the carpal and metacarpal joints. The *articular surfaces* of the several bones are extensively ulcerated, some superficially, others deeply; there is a very abundant formation of new bone around the ulcerated parts. The ulceration was probably the result of inflammation of the wrist-joint. Compare this specimen with I. 40, in which the ulceration was of the strumous variety, and began in the interior of the bones themselves.

II. 30.—Bones of an elbow-joint, exhibiting the effects of inflammation which probably commenced in the joint. The texture of the bones has become porous and spongy, their articular surfaces are ulcerated, and upon the external surface of each bone there is an irregular deposit of new bone in ridges and sharp processes.

Compare the new bone in this specimen with that in II. 20, 22, and Sub-series B. 43, all specimens of chronic rheumatic arthritis.

II. 61.—The excised articular portions of the bones of the elbow-joint. Their articular surfaces are all ulcerated, and in the humerus the ulceration has extended deeply. The ulcerated surfaces are *hard* and in parts *smooth*, as if the ulceration had not been progressive at the time of the excision. The surfaces of the bones not included in the joint are thinly covered by periosteal new bone.

In the compact tissue of the shafts of long bones.

Ulceration of the shafts of long bones is generally the result of chronic periostitis. The inflammation spreads from the periosteum to the adjacent bone, the compact tissue of which is converted into cancellous, as in ordinary rarifying osteitis. In the superficial layers, where the inflammation is most intense, the rarifying process is continued, and the bone trabeculae are finally worn away, as in the articular ends, by the pressure of the inflammatory material, which, together with the internal layers of the periosteum, either assumes the form of granulation tissue or suppurates and breaks down into pus. In the latter instance the ulceration is frequently combined with necrosis of small portions of the superficial layers of the bone.

On removing the periosteum, the internal surface of which appears covered by granulations, the bone is found superficially excavated, softened, and broken down, while the bone below appears rarified, and, still deeper, sclerosed. Sub-periosteal ossification is likewise generally present on the surface of the shaft around the ulcerated part.

After the inflammation has ceased the excavated surface becomes covered with granulations which undergo ossification, and so in great part restore the loss of substance of the shaft.

I. 51.—A section of a tibia, in which several irregular, thin pieces of the outer wall of the shaft have perished. The surface of the wall around the dead portions of bone is extensively ulcerated, and around this ulcerated part new bone has been extensively formed.

Sub-series A. 57.—Section of a tibia with superficial ulceration, necrosis, and a considerable formation of new bone around the ulcerated surface. The other half of I. 51 (dry).

I. 172.—Portion of a tibia in which a large piece of the middle of the shaft has been destroyed by ulceration and necrosis. The remaining bone is inflamed and new bone has been found around the ulcerated part.

I. 369.—Section of a tibia which had been the seat of chronic inflammation for many years. There is considerable thickening and induration, with ulceration of the front surface; the small cavities containing soft, pulpy, and gritty material, but no sequestrum.

I. 221.—The upper part of a femur, the surface of which is irregularly, and for the most part superficially, ulcerated. Small portions only of the external lamellae remain, and these are in many parts covered by a thin layer of new bone. The epiphyses of the great trochanter and the head of the bone have separated.

These changes were consequent on sloughing over the great trochanter.

Sub-series A. 53.—Portion of a tibia exhibiting superficial and exten-

sive ulceration of the upper half, with new bone about the borders of the ulceration.

Sub-series A. 54.—Portion of a tibia exhibiting deep ulceration of its walls, with thickening and induration of the surrounding bone.

Sub-series A. 80.—Five dorsal vertebræ exhibiting superficial ulceration on the anterior surface of the bodies; the ulceration was connected with a psoas abscess.

Contrast this with I. 55, in which interstitial absorption of the vertebræ has been produced by the pressure of an aneurism. In the latter specimen it will be observed that the fibro-cartilages and contiguous edges of the bodies are entire. See also Sub-series A. 182.

In the layers of bone immediately surrounding the medullary canal, the result of osteo-myelitis.

The process is here similar to that described under ulceration of the shaft following periostitis.

I. 163.—Sections of the head and upper portions of a tibia; the bone around the medullary cavity is irregularly excavated by ulceration. Ulceration has also taken place in the more superficial parts of the head, and the whole structure has been subject to long-continued inflammation.

STRUMOUS CARIES, OR UNHEALTHY ULCERATION.

Strumous, like simple caries, is here regarded merely as a continuation of the rarifying stage of osteitis, as a continuation, however, not of the ordinary healthy variety of osteitis, but of an osteitis of a low or so-called "strumous" type. The characteristic appearances of this form may be therefore referred rather to the nature of the previous inflammation than to any inherent differences in the ulcerative process.

Thus regarded, strumous caries bears to simple caries the same relation as the so-called strumous ulceration bears to ordinary ulceration of soft parts. Many, however, maintain that it is a distinct disease, and restrict the use of the term caries to it alone. It is characterised by the tendency of the inflammatory products to undergo caseous degeneration, by the extensive destruction of the affected part, by the softened, fatty, and oily condition of the bone around, by the little tendency to the formation of new bone, and by the feeble efforts towards repair.

The favourite seats of strumous caries are the cancellous ends of the long bones, the short cancellated bones of the tarsus and carpus, and the cancellated vertebral centra.

The ulcerative process is preceded by a low so-called "strumous"

form of inflammation in the interior of the bone, occasionally, by a "deposit" of miliary tubercles. The inflammatory material, which manifests a marked tendency to caseous changes, gradually makes its way to the surface, where it sets up inflammation of the periosteum and destruction of the articular cartilage and neighbouring joint.

In this condition the bone, which still retains its outward form, is light, soft, and porous, so that it can be cut with a knife; on section its cancelli appear dilated and filled with a reddish jelly-like or tubercular-looking material. The thinned and eroded trabeculae next appear to undergo fatty changes and to break down and disintegrate, whilst the inflammatory material softens into pus. The disintegration (ulceration) may begin either at the surface or in the interior of the bone. In the former case the surface appears irregularly and deeply excavated and covered with a thin ichorous and bloody pus mingled with small portions of broken-down bone; whilst immediately below, the trabeculae are so soft and rotten that they can be readily broken down by the pressure of a probe. On section the bone is found soft and fatty looking, and its cancelli filled with the products of the disintegration of the inflammatory material and osseous trabeculae.

When the disintegration begins in its interior, the bone often becomes reduced to little more than a thin shell from the breaking down and disintegration of the cancellous tissue. In some instances the ulceration may be accompanied by necrosis of small portions of the bone (caries necrotica), or by limited formations of pus (abscesses).

The periosteum becomes vascular, thickened, and loosened from the carious spot, but, as a rule, no new bone is formed around, as in simple ulceration. The adjacent soft parts likewise become thickened and infiltrated, and are frequently found riddled with fistulous passages, lined by characteristic granulations, leading down to the bone. Abscesses, having no necessary connection with the bone beneath, may also be produced by the breaking down of inflammatory material infiltrating the soft tissues.

I. 37.—Sections of the lower end of a tibia and fibula of a child. The walls of the bone are thin and soft, and its cancellous spaces are filled with tuberculous-looking material (probably inflammatory products which have undergone caseous changes).

I. 38 and 39.—Similar specimens.

In all the preceding specimens the cartilages have not as yet become affected.

I. 40.—The bones of two wrists, together with the lower ends of the radii and ulnæ and the metacarpal bones, exhibiting the effects of

strumous ulceration. On the left side the carpal bones are nearly destroyed, and there are large deep cavities, bounded by soft, greasy, crumbling bone, in the adjacent parts of the bones of the forearm and metacarpus.

Compare this with simple ulceration in bones of the wrist, II. 23.

I. 43.—Bones of a knee-joint. The cancellous spaces are infiltrated with a yellow tuberculous-looking material, probably inflammatory products which have undergone caseous degeneration. In some situations ulceration has taken place on the exterior of the diseased bone. The epiphyses are separated from the shaft. The articular cartilages are in some places destroyed.

II. 63.—The great trochanter, with a portion of the shaft and the remains of the neck of a femur, excised from a girl with disease of the hip. The head and almost one third of the neck of the femur were destroyed by ulceration. The remains of the neck and of the whole substance of the trochanter and of the diseased portion of the shaft are soft, light, and thinly walled. See also II. 48.

II. 67.—The head and fragments of the neck of the femur, excised in a case of hip-joint disease. The articular cartilage is removed and the head of the femur is ulcerated. The texture of the bone is soft, and in the recent state was deeply ruddy. The cancellous spaces are in many parts filled with inflammatory material.

I. 307.—An os calcis. In its posterior third is a considerable cavity, which communicated by a sinus with the sole and with the inner side of the foot. It contained foetid pus, and the mass of dead bone seen in one side of the specimen. The bone thus situated was necrosed and separated, but being impacted at the point where the sinus communicated with the cavity there was no evidence during life of the completion of its separation. The bone around the cavity in which the sequestrum is contained is infiltrated with inflammatory material, and in places carious. The man from whom this preparation was taken died of tubercle of the lungs. See also I. 302.

I. 377.—Caries of the os calcis. The foot was removed from a man, aged twenty-one, who had been laid up for nearly two years with suppurating fistula connected with the disease.

NECROSIS.

NECROSIS is the death of the whole or part of a bone, and is analogous to gangrene of the soft parts. It usually affects the compact tissue of the shafts of the long bones, less frequently the cancellous tissue in the ends of the long and interior of the short bones.

When the whole of a bone dies the necrosis is said to be complete, or total; when a part, incomplete, or partial. If only the outermost laminæ perish, it is spoken of as peripheral; if only the innermost (those immediately surrounding the medulla) as central.

Although necrosis is here classed as one of the results of inflammation, it may be produced by other means. The immediate cause, however, can in all cases be traced to the cessation of the circulation through the bone, and the consequent cutting off of the nutritive supply. The conditions that may give rise to this stoppage of the circulation are very numerous, and will be considered under the heads of Inflammatory, Traumatic, and Constitutional causes.

INFLAMMATORY CAUSES.

Inflammation of the periosteum (periostitis), of the medulla (osteo-myelitis), or of the bone itself (ostitis), is a frequent cause of necrosis. In periostitis and osteo-myelitis the death of the bone, as we have already seen, is due to the cutting off of its blood supply in consequence of the destruction of the vessels which run from the periosteum and medulla to the bone. This process is analogous to that which occurs in acute cellulitis, where death of the skin results from the destruction of its vessels which ramify in the cellular tissue.

The necrosis of the jaw so common in lucifer-match makers, appears to be the result of a local periostitis induced by the contact of the phosphorous fumes with the periosteum lining the tooth socket. Mercurial necrosis of the jaw seems also to depend upon inflammation of the periosteum. Both will be more particularly referred to under diseases of the jaws.

In ostitis the cessation of circulation is brought about by the pressure of the inflammatory material upon the blood-vessels contained in the Haversian canals and cancelli—a process which may be compared with that which happens in acute inflammatory gangrene. Necrosis, however, under such conditions is more common than gangrene, as bone from its hard and resisting nature is less capable of rapid distension than soft parts; hence its vessels are more likely to become compressed. It is only, however, when the inflammation is very acute that the inflamed portion of the bone dies; when it is less acute the walls of the Haversian canals and cancelli, as we have seen, gradually yield and disintegrate before the more slowly produced inflammatory material; the vessels therefore escape compression, and molecular death of the bone (ulceration or caries) rather than necrosis results. Portions of bone, however, in the neighbourhood of the inflamed part may die from the impairment of their circulation by the inflammation or ulceration around. Hence the frequent occurrence of necrosis and caries in the same bone. Necrosis following ostitis is most commonly met with in the cancellous tissue in the short and heads of the long bones.

Necrosis following periostitis or osteo-myelitis.

I. 337.—The whole shaft of a femur in a state of necrosis consequent upon acute periostitis. The death of the bone was probably due to the destruction of the vessels of the periosteum by the acute suppuration of this membrane, and to the propagation of the inflammation through the Haversian canals to the medulla.

I. 176.—Section of the shaft of a femur, exhibiting necrosis of a small portion of the inner layers of its wall, consequent upon osteo-myelitis. The rationale of the process is similar to that described in the former specimen of necrosis following periostitis.

I. 177.—The other half of the bone, No. 176, macerated.

I. 322.—Nearly the whole of the lower jaw in a state of necrosis, removed from a man who had been engaged some time in a lucifer-match manufactory.

I. 101.—The second phalanx of a thumb separated after necrosis, which followed a whitlow.

I. 228.—The last phalanx of a thumb which exfoliated, almost entire, in a case of whitlow. Necrosis following a whitlow is due to the destruction of the periosteum by the acute suppuration in the sheath of the flexor tendons.

I. 102.—A lower jaw, nearly the whole body of which suffered necrosis after the administration of a few grains of calomel in a case of fever.

Necrosis following ostitis.

I. 104.—Portion of a tarsus exhibiting necrosis of the os calcis. The whole of the internal cancellous texture of the bone has perished, and was in process of separation from the thin osseous layer constituting its walls. The necrosis appears to have succeeded to a diffuse suppuration through the os calcis, the inflammatory material causing compression of the blood-vessels in the Haversian canals and cancelli.

TRAUMATIC CAUSES.

Necrosis may occur after almost any injury to a bone. Its immediate cause is referable, in the majority of cases, to the destruction of the periosteum or medullary membrane, and to the formation of extensive clots in the vessels contained in the Haversian canals; more rarely, as in the case of an injury to a bone without wounds of the soft parts, it appears to be the result of compression of the blood-vessels by extensive extravasations in the bone, medulla, or under the periosteum. The inflammation, however, which commonly follows injury has a share in its production.

Among the common injuries that produce necrosis in the ways above mentioned are—compound fractures, sawing or trephining, wounds of soft parts exposing the bone, burns, applications of strong acids, or even simple blows or falls upon a bone.

From compound fracture.

I. 20.—Portion of a tibia from a compound fracture. Part of the extremity of the bone has acquired the peculiar white appearance of necrosed bone. Here necrosis was probably caused, not only by the denudation or death of the periosteum, but also by the plugging of some of the vessels of the bone by clots, and compression of others by the products of the inflammation following the injury.

From sawing and trephining.

I. 155.—Portion of a femur from a stump, the sawn end of which has undergone necrosis. This was probably due either to local osteomyelitis following the injury, or to the formation of extensive clots in the divided blood-vessels, cutting off the nutritive supply from the end of the bone.

I. 79.—Portion of a skull which exfoliated after trephining. As in the former specimen of necrosis from sawing, the death of the bone was due either to the formation of extensive clots in the divided blood-vessels, or to otitis following the injury inflicted by the trephine.

From burns and cauterization of the periosteum.

Sub-series A. 104.—A skull-cap in which there has been necrosis of a large portion of both tables of the frontal and right parietal bones. The result of a burn.

I. 7.—Tibia of a dog, exhibiting a portion of its walls, dead and in process of exfoliation after cauterization of the periosteum. These changes resulted partly from the destruction of the periosteum and external layer of bone by the cauterization, and partly from the inflammation following the injury.

I. 19.—Sections of a tibia, of which nearly the whole length and thickness of the walls of the shaft perished after inflammation of the periosteum, produced by the application of nitric acid to a sloughing ulcer in the front of the leg.

From the destruction of the medulla.

I. 9.—Section of the tibia of a dog, in which a large portion of the cancellous tissue and of the walls of the shaft perished from destruction of the medulla. In such a case the necrosis is in part due to the destruction of the vessels of the medulla, and in part to the intense inflammation set up in the surrounding bone as the results of the injury.

From blows or falls.

I. 229.—The lower part of an os coccygis, which necrosed and exfoliated after a fall on the buttocks.

I. 145.—Portion of an upper jaw, with two molar teeth, which separated by exfoliation, from a boy aged six years. The necrosis was consequent on a severe blow upon the face.

CONSTITUTIONAL CAUSES.

Amongst the constitutional causes may be mentioned syphilis, scrofula, rheumatism, and the continued and eruptive fevers. In all these the necrosis is probably due to local inflammations of the periosteum and bone. Acute necrosis, in which large portions of bone, without any evident exciting cause, die, appears to be due to a peculiar constitutional state analogous to that of pyæmia.

Sub-series A. 90.—The skull-cap of a young woman, in which in the course of *syphilis* the greater part of the outer table of the frontal bone suffered necrosis.

I. 102.—A lower jaw, nearly the whole body of which suffered necrosis after the administration of a few grains of calomel in a case of *fever*.

I. 309.—An ulna necrosed in its entire extent, saving its epiphyses, separated and removed during life from a child who had suffered from an attack of the *chicken-pox*. It appeared to result from acute periostitis.

I. 321.—A clavicle in a state of necrosis, following an attack of *glanders* contracted from a glandered horse.

I. 301.—Part of the upper third of the shaft of the humerus which had necrosed, and was removed by operation from a youth of strumous habit, who had suffered from *rheumatism*.

CHARACTERS OF DEAD BONE.

Dead bone can be readily recognised. It is bloodless, white, hard, dry, and sonorous when struck, often becoming brown or black on exposure to the air and discharges. When separated, its free surface is smooth and even, or, if previously inflamed, rough and irregular, its margins serrated and ragged, and its previously attached surface rough and uneven. These appearances, however, vary somewhat, according to the situation, previous condition, &c., of the dead bone.

When previously healthy.

I. 65.—A tibia from a young subject, in which there has been necrosis of nearly the whole shaft. The dead bone, which was previously healthy, is white, bloodless, and smooth.

When previously diseased.

I. 64.—A tibia, exhibiting necrosis of its anterior wall. The dead bone, distinguishable by its black colour, instead of presenting the ordinary smooth appearance, is rough and uneven. This condition is due to the removal of part of its surface by ulceration previous to its death; the black colour has been produced by the action of the air and discharges.

I. 104.—Portion of a tarsus, exhibiting necrosis of the os calcis. The whole internal cancellous structure of the bone has perished, and was in process of separation from the thin osseous layer constituting its walls.

SEPARATION OF THE DEAD BONE.

When from one or more of the causes previously illustrated necrosis has taken place, certain changes are set up in the parts around, whereby the dead bone is separated from the living and the parts restored to their healthy condition. The following brief outline of the process, as it occurs in the superficial layers of the shaft of a previously healthy bone, may be taken as a type of what commonly happens. The numerous modifications depending on the previous condition of the bone, situation of the necrosis, &c., will be referred to under the specimens illustrating these peculiarities.

As the result, say of an injury, a portion of bone dies, the periosteum covering the dead portion, if not already detached, rapidly becomes so; the bone around, from the irritation of the necrosed part, becomes inflamed, and a groove, due to ulceration, forms between the living and the dead, at the expense of the adjacent living bone. The groove deepens, until the dead portion is finally cut off from the surrounding living bone, and lies bathed in pus in a cavity lined with granulations. It is now called a *sequestrum*. The separated periosteum, simultaneously with these changes, ossifies, except at certain spots where it has been perforated by pus and discharges making their way from the dead bone to the surface. These apertures are called *cloacæ*. If the sequestrum is now removed, the cavity that contained it fills with granulations, which subsequently ossify, and finally lead to the restoration of the shaft of the bone. The successive changes which occur in the separation of the necrosed bone will be illustrated under the following heads:

- I. Separation of the periosteum.
- II. Increased vascularity and inflammation of the adjacent living bone.
- III. Formation of a groove around the dead at the expense of the adjacent living bone.
- IV. Complete separation of the dead bone by the deepening and completion of the groove.

I. *Separation of the periosteum.*

The periosteum (when not destroyed as it sometimes is in the case of injury) separates and is pushed to some distance from the

necrosed portion by the accumulation beneath it of blood or pus, according as the necrosis is due to injury or inflammation. Such at least is the most generally received opinion. Some observers, however, and among them Billroth, doubt whether the membrane is ever separated. They think it more probable that what appears to be separated periosteum is merely condensed cellular tissue derived from the soft parts, and that the periosteum itself is in all cases destroyed.

After the periosteum (?) has separated it becomes inflamed, thickened, and lined by a layer of granulations. It finally undergoes ossification, as will be illustrated under the heading of "Formation of new bone."

I. 195.—Section of a tibia. The periosteum is separated from the shaft of the bone in nearly its whole length, and is very vascular, thick, pulpy, and velvet-like on its inner surface. This velvet-like appearance is due to the presence of a layer of granulations.

I. 199.—Section of a boy's tibia, in which there is necrosis of the middle half of the shaft, with detachment of the periosteum and adjacent soft parts from the whole circumference of the dead portion.

I. 10.—Section of a tibia of a dog in which the shaft of the bone, in nearly its whole thickness, died. The periosteum separated from it and is thickened.

II. *Increased vascularity and inflammation of the adjacent living bone.*

In necrosis of inflammatory origin these changes necessarily exist prior to the death of the bone. But in necrosis from other causes the dead bone acts as a foreign body and sets up increased vascularity and inflammation in the bone around, which ultimately lead to further changes, to be presently described. The inflamed bone is recognised in the fresh or wet condition by its pinkish colour, which strongly contrasts with the white appearance of the dead portion and the surrounding healthy bone. Its surface is dotted with red points, the openings of dilated blood-vessels contained in the Haversian canals. These points appear as small apertures in the dry specimen, giving it a worm-eaten appearance.

I. 13.—Section of a tibia, in which necrosis has been produced in the outer layers of a small portion of its walls. The dead bone is distinguished by its yellow colour. The living bone around is inflamed, and can be recognised by its pinkish colour and the red points on its surface.

Sub-series A. 106.—A skull-cap, exhibiting extensive necrosis and ulceration of the whole thickness of the parietal bones. A groove has been formed around the dead portion; the increased vascularity of the

adjoining living bone is indicated by the presence of numerous minute apertures in it. These apertures are the dilated Haversian canals, and in the recent state contained enlarged blood-vessels. The dilatation of the Haversian canals was caused by the pressure of the inflammatory new material formed between the walls of the canals and the vessels contained in them.

III. *Formation of groove around the dead at the expense of the adjacent living bone.*

This, the next change in the process of separation, may be compared with the formation of the line of demarcation in gangrene. The inflammation immediately surrounding the necrosed spot terminates in ulceration, the animal matter is destroyed, the earthy particles are set free, and a groove of separation is commenced, which becomes lined with granulations formed by the differentiation of the inflammatory material external to the line of ulceration. The necrosed part thus separating is analogous to the slough in gangrene.

I. 2.—Section of a tibia. In this specimen the bone surrounding the dead portion was previously healthy, but has become inflamed, and has begun to ulcerate beneath the lower part of the dead piece of bone, where a distinct groove without granulations may be seen. The upper half of the dead piece of bone is already separated from the living, the ulceration having proceeded further in this situation; the groove is here lined with granulations, known in the specimen by their soft, reddish, vascular appearance.

I. 13.—Section of a tibia of a dog, in which necrosis has been produced in the outer layers of a small portion of its walls. In one situation the formation of a groove between the living and dead bone has commenced.

IV. *Complete separation of the dead bone by the deepening and completion of the groove.*

As the ulceration advances the groove gradually deepens until the dead bone is completely cut off from the living, and lies free, bathed in pus, in a cavity lined with granulations.

In the more common forms of necrosis the dead is not completely surrounded by living bone, but is in certain situations in contact with the periosteum. Under these circumstances the periosteum may either share in the death of the bone, or separate from it and undergo ossification. In the former case the necrosed bone is readily cast off from the living, and is said to *exfoliate*, the dead portion being called an *exfoliation*; whilst in the latter it becomes enclosed on all sides in a case of new bone (formed in part by the

surrounding living bone, and in part by the ossified periosteum), from which it cannot easily escape; it is then said to be *invaginated*, and is called a *sequestrum*.

I. 19.—Section of a tibia, of which nearly the whole length and thickness of the walls of the shaft perished, and were in process of separation from the cancellous and medullary texture, which has preserved its vitality and a nearly healthy condition. The groove formed between the dead and living bone is filled with soft vascular granulations.

I. 5.—Parts of a femur, a portion of the whole thickness of the shaft of which died and was separated. The dead bone is contained in a cavity formed by the deepening and completion of the groove. The cavity is lined with granulations.

I. 165.—The finger of an adult, in which there is necrosis of the first phalanx in one half of its length, including the distal articular end. The extent of the dead bone is marked by bristles introduced between it and the surrounding parts. The separation of the dead bone is complete, but no new bone has been formed in its place.

I. 8.—A tibia of a dog, from which a portion of the wall has entirely exfoliated. The surface from which the dead bone has been separated is very vascular, and new bone is deposited in considerable quantity on the surface of the shaft, around and opposite to it.

FORMATION OF NEW BONE.

While the dead bone is separating new bone is being produced in the parts around. As already stated, the periosteum, if it does not share in the death of the bone, separates from it, becomes inflamed, and lined with a layer of vascular granulations, which finally undergo ossification. The new bone is at first porous and rough on the surface, somewhat resembling callus, but if the sequestrum be removed it soon becomes smooth and compact, and ultimately differs but little, if at all, from ordinary bone. Its external surface is covered by what is generally regarded as the superficial layers of the old periosteum, although some who maintain that that membrane is always destroyed, affirm that it is merely condensed cellular tissue derived from the surrounding soft parts. Be this as it may, it is distinctly continuous with the old periosteum covering the healthy bone, from which it cannot ultimately be distinguished. The internal surface of the new bone, that next the sequestrum, is lined with granulations.

Ossification, however, is not confined to that portion of the periosteum which was in contact with the necrosed part, but extends for some distance beyond it, between the periosteum and the original wall of the shaft, thus completing the osseous cavity for the sequestrum. The new bone in this situation is produced both from the

periosteum and the old bone. Ossification of the inflammatory material in the inflamed bone around the diseased spot also occurs.

I. 10.—Section of the tibia of a dog in which the shaft of the bone in its whole length and nearly its whole thickness died. The periosteum separated from it and is thickened. Upon the internal surface of the separated periosteum the formation of new bone has taken place in small irregular deposits, and it will be observed that these are all opposite to those parts on which the surface of the dead shaft is rough, making it probable that the new bone is formed on portions of the surface of the old shaft, which separated with the periosteum and served as a kind of nuclei for the growth of new bone. The old bone at its extremities still retains connection with the periosteum, hence it has received some of the fluid injected into the blood-vessels.

I. 11.—Section of the tibia of a dog, in which, as in the preceding specimen, nearly the whole shaft of the bone died. The dead bone is in process of separation, and new bone is formed around it in much larger quantities than in the preceding specimen, and apparently in the deeper layers of the periosteum, the superficial laminae of which appear to cover the outer surface of the new bone, and are, to all appearances, continuous with the periosteum covering the old shaft.

I. 15.—Section of the radius and ulna of a dog, exhibiting necrosis of a portion of the shaft of the former. The dead bone is completely separated, and new bone is abundantly formed around it. The cavity in which the sequestrum is contained is lined with granulations, which cover the contiguous surfaces of both the old and new bone.

I. 7.—A tibia of a dog, exhibiting a portion of its wall dead and in the process of exfoliation. The dead bone is distinguishable from the living by its whiter colour; its separation is almost complete. New bony matter is heaped upon the living bone around the dead bone, as well as in a thick layer on that side of the shaft which is opposite the seat of the necrosis. The periosteum has been in part detached from the tibia, to show that the new bone is entirely beneath this membrane, having been formed between it and the surface of the original wall of the bone, with which, however, it has completely coalesced.

FORMATION OF CLOACÆ.

At certain situations the separated periosteum and contiguous soft parts become perforated by the pus and discharges from the dead bone making their way to the surface. Where the periosteum is thus destroyed no new bone is produced, and the holes thus left in the osseous capsule are called *cloacæ*. The passages leading through the soft parts from these openings to the adjacent skin become lined with granulations, and remain permanently open so long as the sequestrum is not removed or cast out. A characteristic fungous granulation generally projects from the cutaneous ends of these sinuses.

I. 133.—Section of a tibia from a boy, in which there has been necrosis of a large portion of the whole thickness of the wall. The largest piece of the dead bone has been removed, and is preserved in specimen I. 133A. On the inner surface of the separated periosteum a layer of new bone, half an inch thick, and forming almost a new wall to the tibia, has been produced.

An aperture is seen in the covering of new bone leading from the pus cavity, in which the sequestrum is contained, to the surface of the skin, a portion of which is left and formed part of the boundaries of an external ulcer, exposing the dead bone on the front of the leg.

Sub-series A. 94.—Part of a tibia, in which there has been necrosis of a portion of the shaft. The dead bone is completely separated and lies loose in a cavity surrounded by new bone, but it is too large to be removed through any of the cloacæ in the new bone. See also Sub-series A. 97 and 98, and I. 264.

In rare instances no cloacæ are formed, a fact believed to depend upon delayed separation of the sequestrum and the consequent absence or delay of suppuration.

Sub-series A. 118.—Sections of a femur, in which a portion of the whole circumference of the inner layers of its walls has perished and has been separated from the surrounding bone. New bone has been abundantly formed in and upon the outer layers of the wall which separated from the sequestrum. There is not in this new bone any aperture, or cloaca leading into the narrow space around the sequestrum.

Sub-series A. 119.—Sections of a tibia. A sequestrum of a large portion of the inner layers of its wall is completely enclosed within the thick and hard layer of new bone formed in and united with the remaining portions of the walls. There is no aperture leading through the new bone to the cavity containing the sequestrum.

RESTORATION OF THE SHAFT AFTER REMOVAL OF THE SEQUESTRUM.

When the sequestrum is removed the cavity in which it was contained becomes filled with granulations that have grown inwards from the contiguous walls. These undergo ossification and the shaft is finally restored. Whether or not the medullary cavity is reproduced is not determined.

SPECIAL FORMS OF NECROSIS.

The general nature of necrosis having been described, it remains to point out the modifications depending upon the seat of the disease.

*Necrosis chiefly affecting the outer layers of the wall of a bone
(peripheral necrosis).*

When necrosis attacks the outer layers only, the dead portion, as we have already seen, may become invaginated by the ossification of the periosteal sheath ; if the latter is wanting, it is cast off or exfoliated.

The periosteal sheath is absent when the soft parts covering the dead bone have been extensively destroyed, and when the necrosis affects the bones of the skull, the bones of the tarsus, and the lower part of the posterior surface of the shaft of the femur.

I. 7.—A tibia of a dog, exhibiting a portion of its wall, dead, and in process of exfoliation, the result of the extensive destruction of the periosteum produced by the application of the actual cautery to the bone.

Sub-series A. 90.—The skull-cap of a young woman, in which the greater part of the outer table of the frontal bone has suffered necrosis and was in process of exfoliation.

Sub-series A. 96.—Portion of a femur, in which there had been necrosis of the posterior wall of the lower part of the shaft. The dead bone was separated, and was held *only* by a *bridge* of new bone formed across it.

Necrosis chiefly affecting the inner layers (central necrosis).

Central necrosis is generally the result of a circumscribed osteomyelitis. The dead bone, from its inability to escape, often remains a source of irritation for years, and causes great thickening of the bone around. Fistulous passages, the result of the pus and discharges making their way through the healthy bone, commonly extend from the cavity containing the sequestrum to the surface.

I. 176.—Section of the shaft of a femur, exhibiting a fistulous cavity in its interior, with necrosis of a small portion of the inner layer of its walls. Two bristles are placed in a groove, extending to some depth between the dead and the contiguous living bone. A vascular membrane, having a soft velvet-like surface, lines the fistulous cavity in the bone.

I. 177.—The other half of the bone, 176, macerated. See also I. 9 and 132, and Sub-series A. 97, 100, 118, and 119.

Necrosis chiefly affecting the intermediate layers of the wall of a bone.

I. 267.—Sections of a tibia, in which large portions of the wall are separated after necrosis. The separated portions include only the middle laminae of the wall. The sequestra thus lie in cavities between the separated internal and external laminae of the wall.

Necrosis affecting the cancellous tissue.

Where necrosis affects the cancellous tissue, which it occasionally does, though much less frequently than the compact, it is the result of chronic osteitis, and is commonly accompanied by ulceration. It frequently leads to inflammation and destruction of the neighbouring joint, either from the escape of pus into the joint or from extension of the inflammation to the synovial membrane.

I. 4.—Sections of a tibia, in which a portion of the cancellous tissue of the head died and was separated; it lay loose within a large cavity in the head of the bone, which is lined by soft vascular tissue, and the opposite walls of which are shown in the two sections. The periosteum, thickened and vascular, has been partially reflected, to show the rough external surface formed by the accumulation of new bone on the outer surface of the head of the tibia.

I. 193.—A clavicle, in which a piece of the cancellous texture near its sternal end has suffered necrosis. The dead bone lies loose within a cavity, in which it is partially exposed by apertures formed in the surrounding walls of the bones.

I. 242.—Sections of a tibia, of which a portion of the cancellous tissue near its lower end has suffered necrosis and has been separated. The sequestrum lay loose in a cavity lined by a thin organised membrane. The walls of the bone around the cavity are slightly enlarged, and there are two ulcerated apertures extending through them, but their texture, as well as that of the periosteum, is nearly healthy. There is also a wide ulcerated aperture through the articular surface of the bone, and nearly the whole of the cartilage is removed. The disease had existed many years. Numerous abscesses about the ankle rendered amputation necessary.

I. 268.—A similar specimen. See also I. 123.

I. 357. Lower end of the left femur from a man, aged twenty-nine, who was admitted into the hospital on account of disease of the bone of nearly ten years' duration. The thigh was amputated at the patient's urgent request. A small, loose, rugged sequestrum was found on section deeply seated in the internal condyle. The bone around the sequestrum was in a state of inflammatory thickening. The knee-joint was not affected.

I. 153.—A great toe with its metatarsal bone removed by operation. There has been necrosis of a portion of the interior of the metatarsal bone. The sequestrum lies within a cavity, which is lined by soft vascular granulations, and opens externally by fistulous apertures in the skin. The inflammation accompanying the processes consequent on the necrosis of the metatarsal bone has extended to the first joint of the toe, and has produced the complete destruction of its articular cartilages.

I. 243.—An os calcis, in which there was necrosis of a portion of the cancellous tissue consequent upon osteitis. Ulceration also extended

through the superior articular surface of the os calcis. The disease commenced shortly after a rusty nail had been driven into the heel piercing the bone.

Necrosis affecting the whole thickness of the shaft of the bone.

Necrosis of the whole thickness of the shaft is usually the result of acute periostitis, osteo-myelitis, or in rare instances of chronic ostitis.

I. 262.—A tibia, from which a portion of the shaft, nearly four inches in length and including both the walls and the medullary tube, separated after necrosis. The remaining portions of the shaft are connected by a thick band of tough ligamentous tissue, attached to their gradually attenuated ends. They are also soft, light, and smooth on their surface, as if extremely atrophied. Ligamentous union of the tibia and astragalus appeared to have existed. The fibula is healthy.

From a girl, in whom the disease had long existed. The leg could not be used in walking.

I. 158.—The greater part of the shaft of a young person's fibula, which was attacked by necrosis. The death of the bone occurred without obvious cause. Its separation was effected by exfoliation, and new bone was formed in its place.

Mr. Marrant Baker* has drawn attention to a form of necrosis affecting the whole thickness of the shaft, which he calls *intra-osseous*, from the fact that the sequestrum, instead of lying loose in its bony case, as in ordinary necrosis, is held immovably fixed by the formation of new bone on its endosteal as well as upon its periosteal aspect. "A transverse section best brings to mind the condition present. Outside is the shell of periosteal new bone; next within is a more or less complete tube of dead bone; while innermost is the section of the solid endosteal rod of new bone, on which the dead bone is placed like a ferrule."

This form of necrosis is believed by Mr. Baker to depend upon chronic ostitis, for, as will be seen in the accompanying specimens, the "conditions characteristic of complete necrosis, so well marked in one part of the bone, are replaced in other parts by conditions equally characteristic of chronic ostitis with hypertrophy and sclerosis; while connecting the two, there is an intermediate or neutral territory, in which it is difficult to say whether the term necrosis or chronic ostitis is the more appropriate."

Another peculiarity in this form of necrosis is the long delay which occurs in the separation of the sequestrum from the living bone and the consequent absence or delay of suppuration.

* See 'Med.-Chir. Trans.,' vol. lx, p. 187.

I. 379.—Section of a femur, removed by amputation at the hip-joint. Nearly the whole of the shaft has perished, and before the operation the bone had undergone so-called spontaneous fracture; but at no time, either before or after the operation, could any trace of suppuration be discovered. "The dead bone is not at all points loosened from its connections. Near the trochanters it is still continuous with the cancellous tissue of the interior, and at the lower end of the bone, near the condyles, the same connection is observable. Between these two points, moreover, the medullary canal is encroached upon, more at the lower than the upper part, by new bone, which has been formed within the sequestrum, and which is continuous with the cancellous bone of the articular extremities and of the immediately adjacent portion of the shaft. On the outer aspect of the sequestrum dense and hard new bone has been everywhere laid down by the periosteum, so as to form a moderately thick sheath, which closely envelopes the dead bone, so closely, indeed, that at some points it is difficult to make out any line of separation. Where the shaft has not perished in its whole thickness the new bone and the old are continuous, so that, one might say, at these points there is *hypertrophy* instead of *necrosis*. The periosteal sheath of new bone extends from just above the cartilage of the condyles to the trochanters and around the whole circumference of the bone, excepting one or two small openings at which the dead bone lies exposed. But these openings look rather as if they were made accidentally after the removal of the limb than like cloacæ formed during life.

Sub-series A. 95.—Sections of a femur, in which there has been necrosis of nearly the whole length and thickness of the walls of the shaft. There are several round and oval apertures leading through the bone into the narrow space by which it is separated from the surface of the sequestrum. The sequestrum is in most parts immovable, and for various reasons; in the first place it is still in direct continuity with that portion of the shaft which has not perished, and there is no indication of even the commencement of a line of demarcation. Indeed, the only distinguishing mark is the appearance of the dead bone, which is whiter and smoother than the apparently living. The sequestrum is also riveted by new cancellous bone, which extends into its medullary canal for some little distance from the cancellous bone of the articular extremities. Here and there, moreover, through a 'break' in the sequestrum, *i. e.* where the original shaft has not perished, the new bone without and within has become continuous, so as still further to lock the dead bone." See also Sub-series A. 118 and 119.

Necrosis affecting the whole diaphysis of the shaft of a long bone.

Death of the whole diaphysis is commonly the result of acute periostitis, osteo-mylitis, or of an unknown cause, as in some cases of "acute necrosis."

I. 140.—A tibia, the whole diaphysis of which had suffered necrosis.

Necrosis affecting the epiphysis only.

I. 73.—Portion of a radius, in which necrosis has taken place in a piece of its lower epiphysis and articular surface. There is abundant deposit of new bone on the sound bone immediately around the diseased part.

Necrosis affecting the whole of a bone—diaphysis and epiphyses.

I. 195.—A tibia, of which the whole shaft and both epiphyses have suffered necrosis; the result of osteo-myelitis.

ACUTE NECROSIS.

Acute necrosis, or rapid death of bone, as we have already seen, is a common result of diffuse suppurative periostitis or osteo-myelitis. It may occur, however, in rare instances without any evident inflammation of the periosteum and medulla or other cause to account for it. Under these circumstances the bone is found dead, but neither the periosteum nor medullary membrane is thickened or separated. It is possible that necrosis is then the result of a peculiar state of the constitution analogous to that which exists in pyæmia. Be this as it may, death from pyæmia is very common in this form of necrosis.

Acute necrosis from periostitis.

I. 340.—A tibia. The periosteum is acutely inflamed and separated from the whole surface of the shaft, which is bare and dead. The patient died of pyæmia. (Commencing abscesses in the lungs and on both surfaces of the heart are seen in XIV. 84.)

Without known cause.

I. 371.—Acute necrosis of a large portion of the shaft of the femur, in an infant fifteen months old, of only a few weeks' duration. Spontaneous fracture of the bone occurred a few days before death. Amputation was performed. The disease was confined to the diaphysis, which is seen to be separated from the epiphysis. No new bone was formed. The knee-joint was not affected. The disease is said to have been *spontaneous*.

I. 349.—Acute necrosis of the os calcis.

SUPPURATION AND ABSCESS.

Acute suppuration in bone has already been described under osteo-myelitis. It remains to discuss the chronic form.

CHRONIC ABSCESS.

Chronic abscess generally occurs in the cancellous tissue in the ends of the long bones, especially those entering into the knee-

and elbow-joints. In rare instances it is met with in other bones, *e.g.* the sternum, ribs, and clavicle. It is usually the result of chronic osteitis; the central portion of the inflamed tissue softens into pus, while the inflammatory material in the surrounding bone undergoes ossification and becomes the abscess-wall.

The abscess cavity is lined by a soft vascular, pus-secreting (pyogenic) membrane, and the bone around is generally sclerosed. Upon the outer surface of the part of the bone corresponding with the cavity in its interior, there is often a considerable deposit of new bone, the result of irritation of the periosteum. Chronic abscesses are generally single; they vary from the size of a pea to that of a hen's egg, and are generally, but not always, productive of some amount of enlargement of the end of the bone. Intermittent attacks of inflammation of the synovial membrane of the neighbouring joint are very common in the course of the disease. Perforation of the joint sometimes occurs.

I. 82.—Sections of the lower part of the tibia, in the articular end of which is a chronic abscess. The cavity is lined by a vascular membrane a line in thickness, and it contained a puriform fluid. There is a small aperture in one side of the cavity which penetrated the wall of the bone, but with this exception the bone around the cavity appears healthy, and the joint is not implicated.

I. 103.—Portion of a tibia with a circumscribed, smooth-walled cavity in the cancellous texture of its head; this cavity was filled with pus and is lined by a soft vascular membrane. It opens by two apertures through the walls of the tibia; the rest of the bone appears healthy.

I. 184.—The head of a tibia in which there are numerous cavities, the remains of abscesses within the bone.

I. 70.—A section of the lower end of the femur of a child, in which there is a circumscribed abscess. It is situated in the cancellous texture immediately above the epiphysis, through which also a channel appears to have led from the abscess cavity into the joint. The internal surface is very smooth and lined by a membrane, a part of which is still seen.

I. 367.—The upper part of a tibia, which is occupied by a large circumscribed abscess of an hour-glass shape, lined by a pyogenic membrane. It was removed by amputation through the knee-joint from a man who had suffered from intermittent attacks of inflammation and suppuration in the upper part of his leg for years.

2. AFFECTIONS DEPENDENT UPON SIMPLE DEFECT OR INCREASE IN NUTRITION.

ATROPHY OF BONE.

Atrophy of bone is the result of defective nutrition. It may occur as a senile change, or from disuse consequent upon disease or

injury of the bone itself, or of some part in relation with it. It may also be induced by long-continued pressure (as that of an aneurism), in which case it is sometimes spoken of as interstitial absorption of bone or even as caries.

Atrophy is manifested by wasting and rarefaction of the compact tissue. It is always attended by loss in weight, frequently by decrease in size, and fatty degeneration of the bone trabeculæ. It may proceed to such an extent that in extreme cases but little more of the bone remains than a thin shell enclosing a few scattered trabeculæ. Atrophy may be divided into *eccentric* and *concentric*.

ECCENTRIC ATROPHY.

The eccentric is that variety of atrophy in which the compact is simply converted into cancellous tissue, the change taking place from within outwards, so that the bone, although lighter, still retains its outward form and appearance. It is always accompanied by fatty degeneration, and generally occurs in the old.

From old age.

I. 206.—Section of the upper part of a femur from a very aged woman. Its texture is remarkably soft and light and contains an abundance of fatty matter, which on maceration has assumed the appearance of adipocire. The walls of the femur are at their thickest part not more than a line in thickness; the neck is shortened and is rather less oblique than natural; the head is reduced in size and irregularly flattened.

From disuse.

I. 92.—Section of a femur, the shaft of which was fractured about two inches below the lesser trochanter, after atrophy and softening of its texture. The fractured portions have united firmly and smoothly, but so that they form an acute angle. The posterior surface of the head of the femur is absorbed, and here, in the altered position of the lower extremity, it rested on the margin of the acetabulum.

The other half of the bone and the opposite femur, which was similarly fractured and united, are preserved in Sub-series C. 116. The patient, who was fifty-six years old, had been bedridden for some years before the fractures occurred; they were both produced while he was being turned in bed.

Sub-series A. 92.—Sections of a femur, in which there is an enlargement of the medullary cavity, with thinning of the walls and general lightness and dryness of texture.

CONCENTRIC ATROPHY.

The concentric is that variety of atrophy in which the wasting

takes place from without inwards, so that the bone decreases in size. It may occur in the young as well as in the old, and is generally the result of disuse. Hence it is common in stumps after amputation, and in bones that have been subjected to prolonged rest from joint disease or ununited fractures.

From disuse after amputation.

I. 91.—Sections of the stump of a humerus, exhibiting the results of atrophy from long disuse after amputation. The sawn end tapers to a small cone; the walls of the shaft are less than a line in thickness, light and dry, and nearly all the osseous part of its cancellous tissue being removed, the medullary tube appears upon maceration like a smooth-walled cavity.

Sub-series A. 157.—A scapula and part of a humerus. The arm had been amputated long before death, and through disuse the bones are atrophied, but the humerus in a much greater degree than the scapula. The shaft of the humerus has less than half its natural diameter and tapers to a slender cone, at the end of which there is some rough new bone. The marks of the attachments of muscles on it are nearly obliterated, and the texture is light and dry. The head of the humerus is flattened and nearly all absorbed, and there is a corresponding diminution and change of form in the glenoid cavity.

Sub-series A. 158.—An os innominatum and part of a femur. After amputation through the middle of its shaft, the stump of the femur has been atrophied, just as the humerus in the specimen last described, but its head and the acetabulum are unchanged.

Sub-series A. 159.—The stumps of a tibia and fibula after amputation just below the knee. Their medullary cavities are nearly closed by a layer of bone, and they are scarcely reduced in size, but their texture is very light and greasy.

From disuse consequent upon joint disease.

I. 263.—Sections of the upper part of a tibia, exhibiting the effects of extreme atrophy. The walls are so thin that they are in nearly every part transparent. The interior of the bone is filled with soft fat, intersected by few and very slender trabeculae. The articular surface is ulcerated and partly covered with the fibrous tissue of adhesions.

I. 264.—A section of the shaft and lower end of the same tibia partially macerated. It presents the same character of atrophy as the preceding specimens, and shows in a more marked manner the diminution of size, which is associated with the thinning of the walls, and the proportionate increase of fat.

The patient was a lad, fifteen years old, who had suffered for more than a year with disease of the knee-joint. The limb had been kept constantly at rest.

I. 303.—The lower extremity of an atrophied femur. Its compact walls are extremely thin, the anterior bent, the posterior fractured. Some dense fibro-cellular tissue stretches like the string of a bow from

the extremity of the condyles to the shaft above the point of fracture. From a child whose limb was amputated on account of long-standing disease of the knee-joint.

From disease after fracture.

I. 265.—The right femur of a child, eleven years old, which was fractured in the middle third of the shaft four years before death, and in which no union of the fragments took place. The whole of the bone is exceedingly atrophied.

From pressure.

I. 55.—A section of four dorsal and lumbar vertebræ, the bodies of which have been deeply hollowed out by absorption consequent on the pressure of an aneurism of the aorta.

HYPERTROPHY OF BONE.

By hypertrophy of bone we mean augmentation of its structure, where such augmentation cannot be traced to inflammatory origin; the term therefore must be confined to extra growth brought about by increased nutrition either to meet an increased functional activity in the bone itself or surrounding parts, in which case it ought more properly to be regarded merely as healthy growth, or to enable the bone to accommodate itself to the changed form of the organs which it may be destined to protect. The latter is illustrated by the two forms of hypertrophy of the cranium of Sir James Paget, which he designates eccentric and concentric, the one in which the growth takes place outwardly, as in hydrocephalus, to form a covering for an expanding brain, the other in which growth takes place inwardly to fill up the space left by a retreating brain.

ECCENTRIC HYPERTROPHY.

Sub-series E. I.—An enlarged skull, from a child ten years old, consequent upon hydrocephalus. See also Sub-series E. 2, 3, and A. 181.

CONCENTRIC HYPERTROPHY.

Sub-series A. 37.—A skull-cap, in which there is an irregular increase in the thickness of the diploë, producing large convex elevations of the outer surface about the prominences marking the original centres of ossification of the parietal bones. The diploë is consolidated as well as thickened; the outer table is smooth and healthy; the inner table is deeply impressed by the vascular grooves. The cavity of the skull appears to have been small, especially in the parts beneath the external elevations. See also Sub-series A. 39, 43, and 45.

3. CONSTITUTIONAL AFFECTIONS OF BONE.

SYPHILIS.

Syphilitic affections of the bones commonly, though not invariably, occur late in the progress of constitutional syphilis, during the so-called tertiary stage, after the periods at which the skin and mucous membranes are usually affected.

Syphilis in bone is essentially of an inflammatory nature, and may manifest itself under any of the forms of inflammation already described. Hence we have syphilitic periostitis, osteitis, caries, necrosis, &c. In whichever of these forms it may occur the disease is characterised, like all the later syphilitic affections, by its limited extent, by its tendency to the production of large quantities of new material (gummata), and by the fibroid thickenings left should the inflammatory material be absorbed.

SYPHILITIC PERIOSTITIS AND OSTITIS.

Periostitis, when of syphilitic origin, is nearly always chronic and of limited extent; it is productive of those low, smooth, circumscribed elevations, so characteristic of syphilis, called nodes.

Under appropriate treatment these nodes seem entirely to be absorbed, although when an opportunity occurs of examining the bone after death, depressed stellate, fibroid-looking cicatrices of the periosteum are invariably found where the swellings formerly existed.

If the disease is allowed to run its course the inflammatory material invades the adjacent bone (syphilitic osteitis). One of two changes next occurs; the inflammatory material forming the node, together with that infiltrating the bone, either undergoes ossification, producing those permanent swellings and densely thickened bones so common in syphilis, or disintegrates and caries or necrosis is the result. The former is more common in the lower extremities, the latter in the bones of the cranium. See Sub-series A. 8, 10, 13, and many others, for specimens of syphilitic nodes. The differences between ossified syphilitic nodes and the node-like swellings on the bones consequent upon the irritation of chronic ulcers of the integuments have already been pointed out (see page 5).

SYPHILITIC CARIES OR ULCERATION.

Syphilitic ulceration, as above stated, is the result of syphilitic inflammation of the periosteum and bone. The following varieties have been described as characteristic of syphilis—

1, the annular; 2, the tuberculated; 3, the penetrating; 4, the reticulated.

The annular variety.

These annular ulcers have been compared to the rupial ulcers of the skin. They present an annular form, an ulcerated groove extending round a central portion of diseased bone, which portion is gradually removed as the groove widens towards the centre.

Sub-series A. 63.—A skull-cap, exhibiting extensive syphilitic ulceration of its outer table. The ulcers are distinct, large, and round. Some of them, especially one on the frontal bone, show that they commenced in an annular form, an ulcerated groove forming round a portion of diseased bone, which portion was subsequently removed by the widening of the groove. The inner table is very vascular, and less extensively ulcerated. See also Sub-series A. 70 and 109.

The tuberculated variety.

This variety, so called because the ulceration is preceded by a tubercular condition of the bone, is the result of syphilitic otitis and not of periostitis. The small cell-infiltration in the substance of the bone raises the surface into irregular tubercular elevations, and subsequently, by destroying circumscribed portions of the bone, produces ulcers. The ulcers are small, circular, or oval; they often penetrate somewhat deeply into the bone. From the fact of both being preceded by a tubercular condition, this ulceration has been compared with tubercular syphilitic ulceration of the skin.

Sub-series A. 35.—The skull, femur, and bones of the right upper extremity of a man who died with syphilis. The tuberculated character which the outer table of the skull assumes, previous to its ulceration, is shown on the upper part of the frontal bone; and the stages in the progress of the little ulcers which penetrate and spread through the new bone may be traced on the clavicles in which the process has just begun, and on the radius and humerus on which it is more advanced; while on the femur, whose shaft like theirs is much enlarged by the formation of new bone, there are many small round and oval apertures with smooth borders, indicating that similar ulcers have been healed.

Sub-series A. 82.—A skull-cap, exhibiting extensive tuberculated syphilitic ulcerations of the parietal bones with thickening and hardening of the inner table.

Sub-series A. 89.—A skull, exhibiting the effects of syphilis. The outer table of nearly all the upper part of the skull is tuberculated and very extensively ulcerated, and in several places the ulceration has penetrated the inner table.

Sub-series A. 59.—A skull-cap, large portions of which have been destroyed by syphilitic ulceration like that in the preceding specimens.

The two preceding specimens were taken from patients who died in the venereal wards of the hospital.

The reticulated variety.

This variety is so called because the ulceration is preceded or accompanied by a trellis-work-like or reticulated formation of new bone around the ulcers, the result of ossifying periostitis.

Sub-series A. 52 and 86.

See also the humerus in Sub-series A. 34.

The penetrating variety.

This is merely a modification of any of the former varieties of ulceration in which the bone is penetrated deeply. It is common in the bones of the cranium, rare in long bones. In the latter it has sometimes been a cause of spontaneous fracture.

Sub-series A. 34.—Parts of a tibia, clavicle, humerus, and skull, from a man who died with syphilis. In one part of the shaft of the tibia the walls and the new bone covering them are *penetrated* by small irregular ulcers. The same disease has affected the middle of the clavicle; and in it the ulceration has extended so far that a slight force broke the remaining portion of its shaft. In the humerus the lower half of the shaft is thickly covered by light and porous new bone, through which many ulcers of various size have *penetrated*; some of these extend deep into the original wall of the humerus, portions of which also appear to have suffered necrosis. In the skull the outer tables of the frontal and right parietal bone present an uneven tuberculated surface; through this, numerous distinct and coalescing ulcers *penetrate*, and reaching the diploë spread therein in wider spaces, and in a few instances pass also through the inner table.

SYPHILITIC NECROSIS.

Necrosis from syphilis is most often met with in the bones of the cranium; it is generally the result of suppurative periostitis (the soft node), and then only attacks the outer table, as the inner has a separate blood supply. It also occurs after syphilitic inflammation of the dura mater, and then affects the inner table only for the same reason, or the process may affect both the inner and outer table at the same time. A syphilitic sequestrum, which is separated in the usual way by a groove of ulceration, is generally round, porous, and indented at the edges, the porosity being due to ulceration of the bone previous to its death. The hole left on the separation of the sequestrum is usually round, with jagged and shelving edges, and seldom extends through more than one table. No new bone is usually formed on the outer table around the sequestrum.

Sub-series A. 108.—A skull-cap, exhibiting necrosis of a portion of

the outer table of the frontal bone, with thickening of the inner table to a corresponding extent. The dead bone is black: previous to its necrosis it appears to have been superficially ulcerated. There is a very shallow groove of separation around it.

Sub-series A. 109.—A skull-cap, in which there are several distinct syphilitic ulcers. The ulcers are nearly circular, and affect corresponding parts of both tables. Some of them present an annular form, a groove of ulceration extending round a central portion of necrosed bone, which is gradually removed as the groove widens towards the centre.

Sub-series A. 90.—The skull-cap of a young woman, in which, in the course of syphilis, the greater part of the outer table of the frontal bone suffered necrosis and was nearly separated from the adjacent bone. A deep groove has formed round the dead portion, and a large part of its under surface is separated. The inner table has not perished, but beneath the centre of the necrosed portion there are several irregular ulcerated openings in it.

Sub-series A. 117.—Portion of a skull-cap, exhibiting necrosis of a previously diseased portion of its outer table.

From a patient who had a suppurating node upon the cranium in the situation and to the extent of the surface of bone which has perished.

Sub-series A. 58.—A skull-cap, exhibiting some of the effects of syphilis. In some situations there has been a complete destruction of the bone through both tables of the skull; at the borders of the apertures thus made, the disease seems to have stopped, and the parts appear to have cicatrised, for their edges are thin, smooth, and hard. In other situations ulcerations appear to have been in progress, the bone in these parts exhibiting a rough surface, a porous texture, and many small deeply penetrating holes. The spaces left by the removal of the bone are filled by membrane in which there are several small deposits of new bone; and the outer surfaces of all the portions of the skull which remain between the ulcers are tuberculated, seamed, and starred. See also Sub-series A. 105 and 107.

STRUMA.

Struma or scrofula manifests itself in bone either as a low form of chronic osteitis commonly terminating in caries or necrosis, or as a deposit of miliary tubercles or of caseous masses resulting therefrom.

STRUMOUS OSTITIS.

Strumous osteitis is merely inflammation of bone occurring in an unhealthy or so-called "strumous" subject. It differs from the simple form of osteitis in its greater liability to terminate in caries or necrosis, and in the tendency of the inflammatory material to undergo caseous degeneration and of the bone corpuscles to undergo

fatty changes. The bone, which retains its outward form, is lighter, softer, and more oily than natural. On section its dilated cancelli appear infiltrated either with a reddish jelly-like mass of inflammatory material, or with a yellowish, cheesy, tuberculous-looking substance, the result of caseous degeneration of the inflammatory products. Moreover, the bone corpuscles on microscopic examination appear to have undergone fatty changes, which would account for the oily condition of the bone. By Cornil and Ranvier these fatty changes are believed to be the cause of the inflammation, not the result.

The favourite seats of strumous osteitis are the bodies of the vertebræ, the short cancellated bones, and the articular ends of the long bones.

I. 37.—Sections of the lower end of a tibia and fibula of a child. The walls of the bone are thin and soft, and its cancellous spaces are filled by tuberculous-looking matter.

I. 38 and 39.—Similar specimens. See also I. 377.

I. 49.—A hip-joint. The head of the femur has been dislocated from the acetabulum on to the dorsum of the ilium. The section of the femur shows tuberculous-looking matter deposited in its cancellous texture. See also II. 6 and 63.

IV. 14.—Section of a spine with angular curvature. The bodies of the vertebræ are infiltrated with tuberculous-looking material, probably the result of caseous degeneration of the inflammatory products produced in the course of chronic osteitis. Ulceration or caries has commenced in the bodies of two of the vertebræ. See also IV. 15, 16, 21, and 43.

TUBERCLE.

It was formerly the custom to designate any caseous deposit in bone as tubercle, under the impression that such deposits were always dependent upon the metamorphosis of true miliary tubercles. It is now known, however, that caseation may be the result, as we have just seen, of the degeneration of inflammatory and other products; it is therefore usual to restrict the term tubercle to "deposits" of true miliary tubercles, or to caseous masses resulting therefrom, and around which the presence of grey granulations can be clearly demonstrated. The favourite seat of true tubercle in bone is, like that of strumous osteitis, in the cancellous tissue, especially that of the sternum and ribs.

Miliary tubercles in bone appear as small, roundish, semi-transparent bodies, resembling tubercles in other parts, and after they have undergone caseous changes, as yellowish deposits of cheesy-looking material infiltrating the trabecular spaces, in which condition it is often impossible to distinguish them from caseous

masses of inflammatory origin. Like the latter they may undergo further changes leading to caries and necrosis.

Tubercles in bone, answering to this description, are undoubtedly but seldom seen, although this is probably in great part due to their presence being rarely sought for where they are most likely to be found, namely, in the sternum and ribs of subjects who have died with the constitutional disease known as "acute tuberculosis."

I. 77.—Portions of a sternum and ribs. There is a large cavity in the sternum filled by tuberculous-looking matter. This cavity was closed in, both behind and in front, by a membrane, apparently the thickened periosteum, a part of which is now reflected. The tubercular material was probably produced either by the degeneration of miliary tubercles or by caseation of inflammatory products.

RICKETS.

Although rickets is generally described as a disease of the bones, it is more probable that it is a constitutional affection of which the bone lesions, although an important, are by no means the only feature. Be this as it may, we are merely concerned in this place with the affection as it manifests itself in the bones, and must refer the student for a full account of the disease to some of the various treatises on the subject.

The characteristic appearances of a bone affected with rickets are as follows:—The periosteum is thickened, vascular, and adherent; the whole bone is softened, so that it can be cut with a knife; the lacunæ appear enlarged, the lamellæ separated, and the medulla and cancellous spaces filled with a red, gelatinous, pulpy material. The long bones are swollen where their shafts join the epiphyses; the cranial and other flat bones are generally thickened.

The above condition is the result of a defect in ossification. The earthy salts are deposited irregularly and in deficient quantity, so that under the periosteum, and at the junction of the shafts with the epiphyses, a layer of spongy, ill-formed bone is produced (osteoid tissue of Virchow). At the same time the reabsorption of the normally-formed bone is taking place around the medullary cavity as in healthy growth, so that thus it comes to pass that the whole is replaced by the new ill-formed bone. While in their softened state the bones become variously bent and distorted, as will be presently described, the various curves and distortions which they assume doubtlessly depending in great part upon mechanical causes. When the disease ceases healthy bone is again formed, and the bones are consolidated in their bent and deformed condition.

I. 34.—A section (cut with a knife) of the femur of a rickety child, curved in consequence of the want of its natural hardness.

I. 35.—Section of the femur and tibia of a child. The bones, which have become curved, have recovered their osseous texture and their inflexibility, but their curvature remains.

I. 36.—Fragments of the upper part of the skull, said to have been obtained from a rickety patient.

DEFORMITIES OF THE BONES IN RICKETS.

The head.

The cranium is slightly enlarged, but appears larger than it absolutely is in consequence of the arrested development of the bones of the face. The forehead is high, square, and prominent. The fontanelles remain open long after they should have closed. The bones of the cranium are generally thickened, soft, and spongy, the thickening being especially apparent where ossification is still progressing, that is, along the line of the sutures. In some instances, however, the bones are not thickened, but are excessively thinned (see I. 346). The teeth are developed late, or if they have been already formed, have a tendency to decay or fall out.

I. 36.—Fragments of the upper part of a skull increased in thickness, said to have been obtained from a rickety patient. See also skull in Sub-series A. 148.

The spine.

The spine commonly presents an increase of its normal curves. If the disease occurs whilst the child is still in arms, the curve assumes the posterior form, in consequence of the tendency of the head and upper part of the body to fall forward as the child is being nursed, and it is usually combined with a slight lateral deviation to the right from the child leaning against the mother's left breast, children being usually held with the left arm. When the disease occurs after the child can run alone, the normal lumbar curve is generally increased (lordosis). In advanced rickets more or less lateral curvature is always present.

Sub-series D. 17.—A spine, thorax, and pelvis. The spine in the dorsal region is curved with its convexity backwards and a little to the right.

Sub-series A. 147.—The spine, pelvis, and lower extremities of a woman. The spine presents three lateral curvatures, the result of rickets.

Sub-series A. 148.—Skeleton of a woman, exhibiting lateral curvature in consequence of rickets.

Sub-series D. 19.—The spine and pelvis of a young person, exhibiting lateral curvature of the spine, probably from rickets.

The thorax.

The rickety thorax is characteristic; its transverse diameter is greatly diminished, and its antero-posterior greatly increased. The deformity, which generally goes by the name of pigeon-breast, is produced by the lateral yielding of the softened ribs to atmospheric pressure during inspiration, and the consequent thrusting forward of the sternum.

On either side, where the cartilages join the ribs, two vertical depressions or grooves are generally observed, in consequence of the greater recession of the chest walls in these situations. The left groove is generally shallower than the right, in consequence of the support which the ribs receive from the heart; whilst the right, though deeper, does not extend so far downwards, on account of the support of the liver. The ribs, where they join the cartilages, are swollen, like the ends of other long bones, giving rise to a characteristic knobbed appearance in this situation.

When much lateral curvature of the spine (the result of the rickets) coexists with deformity of the thorax, the characteristic appearances of the latter are partially obscured.

Sub-series D. 17.—A spine, thorax, and pelvis. As there is but slight lateral deviation of the spine in this specimen, the thorax exhibits the deformity characteristic of rickets uncomplicated by that which always accompanies lateral curvature.

Sub-series A. 146.—The skeleton of a child, exhibiting the effects of rickets. The typical shape of the thorax is obscured by the accompanying lateral curvature of the spine.

Sub-series A. 148.—The skeleton of an adult woman, exhibiting the effects of rickets. The typical shape of the thorax is here also obscured by the coexisting lateral deviation of the spine.

The pelvis.

The pelvis is generally flattened from before backwards, the symphysis pubis being approximated towards the sacrum, whilst the latter is pressed forwards and downwards, giving the pelvic inlet a characteristic hour-glass shape. In rarer instances the pelvis becomes more or less triangular from the approximation of the acetabula. The sacrum is flattened, and placed more horizontally than natural, whilst its apex, together with the coccyx, is curved sharply forwards; the iliac crests are everted, the tuberosities widely separated, and the pubic arch increased in width. In some instances the pelvis is a-symmetrically distorted, probably the result of coexisting lateral curvature.

Sub-series D. 17.—A spine, thorax, and pelvis. The pelvis is of nearly natural form and size, but its obliquity is lessened in conse-

quence of the flattening of the sacrum; its antero-posterior diameter is rather diminished, while its transverse diameter is greatly increased.

Sub-series A. 145.—A female pelvis, the cavity of which is altered in its form and direction, so that the symphysis pubis is nearly opposite the left sacro-iliac symphysis. The change is presumed to be the effect of rickets. There was a slight lateral curve of the spine.

Sub-series A. 150.—The pelvis and lower extremities of a middle-aged woman who had suffered from rickets. The cavity of the pelvis is contracted, especially on the left side, by the pressing in of the acetabulum; but the lower aperture of the pelvis is wide, the rami of the ischia being bent outwards and their tuberosities divergent.

The long bones.

The long bones are usually found bent in the direction of their normal curves, their ends are somewhat swollen and nodular, and their length shorter than natural, in consequence of the early coalescence of the epiphyses. The compact tissue of the shaft is thicker and more condensed than in health, especially along the concavity of the curves. The order in which the long bones are generally affected is—1, bones of lower extremity; 2, the clavicle; 3, bones of upper extremity.

The bones of the lower extremity.—*The femora*, when the disease occurs before the child can run alone, are curved forwards from the weight of the legs bending down the softened bones across the nurse's arms. When the child can walk the weight of the body tends to increase the natural curves and the femora bend forwards and outwards. The neck of the femur becomes more horizontal than natural, but not shortened, and the shaft flattened from side to side. The walls of the bone in the middle and along the concavity of the curve have a greater thickness than elsewhere; the *linea aspera* is very prominent, and often form a straight line, representing, as it were, the cord of the arc formed by the curved part of the shaft. The lower end is broad and flat.

The tibia and fibula are generally curved forwards and inwards, and their shafts are flattened from side to side.

The bones of the feet are turned inwards, so that the great toes sometimes almost touch each other.

Sub-series A. 143.—Section of the rickety femur of an adult. The shaft is greatly curved and laterally flattened; and the section shows that, as usual, the walls of the bone are much thicker on the concave than on the convex side of the curve.

Sub-series A. 144.—The fibula of an adult. Its shaft is curved and flattened. The principal curve is directed with its convexity inwards; but there is also a slight curvature forwards in the upper part of the shaft.

Sub-series A. 138.—A femur, tibia, and fibula from a child. They are all considerably curved from rickets, but have regained their natural firmness. See also Sub-series A. 138, 139, 140, 141, 142, 143, 144, 146, 147, 148, 149, and 150.

The bones of the upper extremity.—*The clavicle* usually presents two curves, one, beginning just externally to the insertion of the sterno-mastoid, the other a little internally to the acromial end. The first has its concavity looking downwards, and is caused by the weight of the arm; the second has its concavity backwards, and is produced by the backward pressure of the arms as the child crawls on its hands and knees.

The humerus is generally curved with its convexity forwards, the curve is produced by the weight of the arm, which is unsupported below the insertion of the deltoid.

The radius and ulna are curved outwards.

Sub-series A. 148.—See clavicle, humerus, radius, and ulna in this specimen.

Sub-series A. 146.—See clavicle, humerus, radius, and ulna in this specimen also.

Having studied separately and in detail the characteristic deformities of the several bones, the student may now take a general survey of the whole rickety skeleton in the following specimens, Sub-series A. 146 and 148.

MOLLITIES OSSIIUM.

Mollities ossium is a rare disease, characterised by softening of the bones through the reabsorption of their earthy salts and destruction of their osseous lamellæ. It is an affection of adult life, and generally occurs in females, especially during pregnancy. The bones of the trunk, and more particularly those of the pelvis, are first affected, but all the bones sooner or later participate in the disease.

In the early stages the bones retain their outward form, but are so soft that they can be cut with a knife. On section the medullary spaces, or in the case of the long bones, the medullary canal also are seen to be slightly enlarged, and filled with a soft gelatinous material, somewhat resembling spleen pulp. The veins of the medulla are said to be engorged and dilated. Later on the bones become still further softened and variously bent, broken, and deformed, while the osseous lamellæ in great part disappear, reducing the bone to little more than a thin shell enclosing a similar substance to that seen in the first stage, but mixed with a fatty-looking material.

On microscopic examination of small portions of the trabeculæ the decalcification is seen to begin around the Haversian canals and medullary spaces, the bone corpuscles in these parts having entirely disappeared, while in the centre of the trabeculæ they are still present. The material infiltrating the medulla is seen to consist of various shaped cells and fatty material.

Another form of disease characterised by softening of the bones has been described as *mollities ossium*, and is what is commonly recognised by that name in this country. It appears to consist of little more than fatty degeneration of the bones. The specimens of *mollities ossium* in the museum appear to be examples of this latter form of disease.

I. 129.—Section of a femur in which that change of structure has taken place which is usually denominated *mollities ossium*. The walls of the bone are very thin, and their substance so soft as to be readily divided by a knife. The osseous lamellæ and filaments are removed from the cancellous texture, and the medullary cavity and all the cells of the cancellous texture are filled by a *fatty* substance, which is now, after maceration and the action of alcohol, of the consistence of lard.

I. 130.—Section of a humerus from the same subject as I. 129. The walls of the bone are thin, but of their natural hardness. The adipose substance filling the medullary cavity and cancellous texture is converted by maceration into a white firm substance resembling adipocire.

From a woman seventy-two years old who had been bed-ridden with paralysis of the lower extremities for nearly two years. Her hip- and knee-joints were fixed in permanent flexion. At short intervals before her death her right femur and right arm were fractured when she was being turned in bed.

I. 233.—Section of a femur affected with *mollities ossium*. The walls of the bone are thin, soft, and flexible, and their lamellæ are partially separated. The place of its medullary and cancellous tissue is occupied by soft, jelly-like, transparent fat, of various shades of yellow and pink; some of it was deep crimson. A similar kind of fat appeared to be diffused through the proper texture of the walls. Scarcely any of the osseous part of the medullary texture remains, except a thin layer beneath the articular surface of the bone. The periosteum and articular cartilage are healthy.

I. 234.—Sections of the upper part of the same femur, and of the patella of the same patient, macerated. The fat diffused through their whole tissue is converted into adipocire. The neck of the femur is a little less oblique than is natural, but it is not shortened, nor is the shape of the head altered.

From a lady thirty years old. The disease had been some years in progress, and had affected in various degrees all the bones of the extremities. This femur had been fractured by a slight force shortly before death.

Sub-series A. 164.—The pelvis of a woman on whom the Cæsarian operation was performed.

Sub-series A. 167 and 180.—Similar specimens.

Compare these specimens with the rickety pelvis in Sub-series D. 17.

4. NEW GROWTHS OR TUMOURS.

New growths in bone bear a general resemblance to those of soft parts. They have, however, a remarkable tendency to undergo ossification and to assume more or less the characters of true bone.

Bone, as we have seen, is built up of several distinct elements—fibrous tissue, cartilage, earthy particles, and medulla. Tumours of bone are composed of the same tissues as those which constitute the bone itself; hence, they may be fibrous, cartilaginous, osseous, marrow-like, &c. But it is only tumours of slow growth which resemble in structure the mature tissues of normal bone; those of rapid growth do not acquire the characters of the mature tissues, but permanently retain a cellular structure; the former are commonly innocent, the latter malignant.

FIBROMATA OR FIBROUS TUMOURS.

Fibrous tumours of bone, except in the jaws, are rare. They have all the physical and microscopical characters of fibrous tumours of soft parts. They are described under tumours of the jaws, as there are no specimens of fibrous tumours of other bones in the Museum.

OSTEOMATA OR OSSEOUS TUMOURS.

The osteomata are tumour-like growths having the structure of true bone. They must be distinguished from those osseous formations which are the result of the ossification or calcification of other tumours, and from the node-like deposits of bone consequent upon inflammation. They are always innocent, generally of slow growth and of small size; occasionally, however, they may attain considerable dimensions.

The osseous tumours may be divided into the exostoses and diffused bony growths.

EXOSTOSES.

Exostoses are circumscribed outgrowths from the surface of a bone. They are usually divided into the cancellous or soft, and

the compact or ivory. The former are more common on the bones of the extremities, the latter on the bones of the skull. Osseous growths of a similar character, in rare instances, are met with projecting into the medullary canal. They are then called *enostoses*.

The cancellous or soft.

These are composed of cancellous surrounded by a thin layer of compact bone. They are commonly continuous with the cancellous and compact tissue of the bone from which they spring, and in most cases contain medulla. They are surrounded either by fibrous tissue continuous with the periosteum, or by a layer of cartilage, in which latter case they are by some regarded merely as ossifying enchondromata. When they spring from the ends of the long bones they are probably outgrowths of the epiphysial cartilages. They are generally single, and are most often found upon the shafts of the long bones at spots where muscles are inserted. They are occasionally multiple.

Exostoses springing from the insertion of muscles.

I. 178.—An exostosis removed from the insertion of the adductor magnus muscle into the femur, just above the inner condyle (*adductor tubercle*), from a girl aged sixteen years. The central part of the tumour consists of cancellous bone, and is surrounded by a layer of cartilage, which is itself surrounded by a thick layer of fibrous tissue. The areolæ of the central cancellous tissue contain marrow.

This is a very common situation for exostoses, and it should be remembered that they are here in close proximity to the synovial membrane of the knee-joint, which may be injured in removing them. Such an accident may best be prevented by flexing the leg on the thigh, whereby the synovial membrane is drawn downwards away from the tumour.

I. 183.—A similar exostosis from a man aged nineteen. The tumour had been united to the femur by a narrow neck, which probably was broken by external violence, for, in the operation, the narrow neck of the tumour was found connected with the femur only by soft substance, being fitted to an excavation in the femur, upon which it had freely moved.

I. 231.—A similar exostosis, the cartilaginous part of which forms a smooth layer, investing the osseous part, and is itself invested by a thin layer of fibrous tissue. The cancellous tissue is filled with medulla. The exostosis was attached by a narrow base.

Sub-series A. 134.—Portion of a femur with an exostosis growing with a long pedicle from the inner and front part of its shaft just above the internal condyle.

I. 105.—Exostosis of humerus, which grew from the insertion of the pectoralis major.

Sub-series A. 131.—Exostosis of the humerus, growing from the insertion of the pectoralis major.

Sub-series A. 128.—A humerus with a broad-based and sharp-edged growth of bone from the outer side of the shaft, close to the attachment of the deltoid muscle.

Sub-series A. 126.—The upper part of a femur, exhibiting a bony process of a pyramidal form continued from the trochanter minor. To the extremity of this bony process the tendon of the psoas and iliacus muscles is attached.

Sub-series A. 127.—The upper part of a femur, exhibiting a bony process like the last described, which was connected with the trochanter minor by ligamentous substance.

Exostoses of the last phalanx of the great toe.

Exostoses of the last phalanx of the great toe are very common. They generally grow from the distal end of the phalanx and, in most cases, from the inner edge of its dorsal surface. As they increase in size they raise up the nail before them, but do not cause much pain except when pressed upon by the boot. They vary from the size of a pea to that of a Spanish nut. They are commonly surrounded by cartilage, occasionally by fibrous tissue. Although exceedingly hard, they are much less compact than those occurring in the cranium.

I. 106.—The last phalanx of a great toe, near the upper end of the internal surface of which there is an osseous tumour composed of hard and finely cancellous bone.

I. 107.—The last phalanx of a great toe, which was removed by operation. The nail is raised and pushed aside by a tumour beneath it. A small portion of the tumour is removed to show that it consists, like the last specimen, of osseous substance.

I. 226.—A similar specimen (macerated).

I. 214.—Section of the last phalanx of a great toe. A small osseous tumour has grown from the anterior and upper part of the bone, and has elevated the nail. It is formed of cancellous tissue surrounded by a thin layer of compact substance.

I. 157.—Sections of the last phalanx of a great toe, exhibiting the growth of an exostosis from its extremity (macerated).

Exostoses on other parts of the last phalanx of the big toe and on the phalanges of other toes are extremely rare. A specimen of exostosis on the last phalanx of the little toe follows.

I. 277.—Section of the last phalanx of a little toe and of an exostosis which has grown from the middle and extremity of its dorsal surface, lifting up the nail.

I. 278.—The other section of the same phalanx and exostosis macerated and dried.

The patient was a woman twenty-five years old. The tumour had been growing regularly, but with scarcely any pain, for two years.

Exostoses springing from parts of the bones other than those above mentioned.

I. 186.—Section of femur, from the surface of which an osseous growth has arisen. The growth is flattened and elongated, and has pointed processes directed downwards. It consists of a cancellous texture surrounded by a thin shell of compact bone, and is attached by a broad base.

I. 222.—Lower part of a femur, from which a broad flat exostosis was removed by operation. The surface from which the exostosis was cut is rough; it is formed of cancellous tissue of healthy aspect; the exostosis is of like nature. The upper margin of the exostosis is very nearly three inches above the border of the articular cartilage of the trochlea of the femur, but the whole of the exostosis was covered by synovial membrane, and projected into the cavity of the knee-joint.

I. 245.—An exostosis from a tibia.

I. 202.—An exostosis from a scapula.

I. 348.—A portion of a lower jaw with an exostosis on its outer surface.

Multiple exostoses.

1. 282.—Specimen of exostosis from a boy who had a number of symmetrical tumours. His father had likewise this disease.

I. 253, 254, 255.—Specimens of multiple exostoses in dogs.

The compact or ivory.

These are composed of compact bone, commonly intermixed with a small proportion of cancellous tissue, which is, however, more closely set than ordinarily. The compact bone is much harder than natural, and the Haversian canals, lacunæ, and canaliculi are smaller, fewer in number, and more irregularly placed. These exostoses are rare, except in connection with the bones of the skull; they are exceedingly hard, ivory-like and compact, and of slow growth. They occur in two forms, one as small, lens-shaped outgrowths from the outer table, with broad or pedunculated bases; the other as nodular masses springing from the diploë. The latter often attain a large size and project into the frontal sinuses, causing great displacement of the soft parts.

I. 71.—Sections of an occipital bone to the lower part of which an ivory exostosis is attached by a narrow base. The outer part of the growth is smooth and very dense; within, it is in part cancellous and in part nearly as dense as ivory. Its textures have coalesced with those of the outer table and diploë of the skull.

I. 297.—An osseous tumour removed from the mastoid portion of the temporal bone. It is of a semi-elliptical shape, and was attached by a comparatively narrow crescentic base, which was with great difficulty separated from the skull.

Sub-series A. 124.—Section of a skull, exhibiting a small ivory-like exostosis with a narrow base growing from the outer table of the frontal bone just above the external angular process.

I. 310.—An ivory exostosis growing from the lower and back part of the parietal bone. It is attached by the central portion of its base only. (Mr. Ilott's well-known case, see the Catalogue.)

I. 316.—An ivory exostosis which has grown into the frontal sinuses.

DIFFUSED OSSEOUS GROWTHS.

These are defined by Sir James Paget as "tumour-like in the most prominent parts, and yet unlike tumours in that their bases of connection with the bones are very ill defined, and that from their bases the morbid changes in which they originated extend outwards on the same or even to other bones, gradually subsiding."

They are composed of finely cancellated bone, more compact than the cancellous exostoses but less compact than the ivory. They generally begin in the walls of the antrum and grow inwards until that cavity is completely filled. They also frequently occur at the same time upon the outer surface of the maxillary bones, and upon the septum and side walls of the nose, they are sometimes symmetrical, as in Mr. Langstaff's case, and occasionally perish and separate, presenting the ordinary phenomena of necrosis.

I. 62.—Section of the bones of the face, exhibiting an osseous growth which nearly fills up the antra. The sections through the antra open to view a small cavity in each. This cavity indicates, as does also the disease of the adjacent bone, that obliteration is the consequence, not of the growth of new distinct tumours into them, but of the thickening of their walls. The new bone by which they are increased in thickness is hard, nearly solid, and heavy; it is almost all formed on their inner surfaces, and only a few small similar growths are elevated on their outer surfaces and project on the face and into one of the orbits. The septum nasi and spongy bones are similarly thickened, enlarged, and very dense in their texture.

I. 259.—A superior maxillary bone in which the cavity of the antrum is completely filled by a growth similar to that in the foregoing specimen. As in the former case, the new growth has taken place principally from the inner surface of the walls of the antrum, but in this specimen the disease has advanced a stage further, and the whole cavity is obliterated. All the external surface of the maxillary bone is superficially tuberculated and porous, its walls being changed into bone of the same texture as that which occupies the place of the antrum. The disease is attended with general but irregular enlargement of the maxillary bone, its alveolar portion alone retains a nearly natural form.

I. 260.—Portions of a superior maxillary bone, diseased like that of

No. 259, and separated after necrosis. The portions before division composed a nearly spherical mass of hard, heavy, and finely cancellous bone.

The patient was a man thirty-seven years old. A small prominence of the nasal process of the right superior maxillary bone had been noticed for two years, but it was not increasing, and he was admitted into the hospital with what appeared to be necrosis of the alveolar portion of the jaw and suppuration around it. After four months this mass of bone which occupied the antrum completely separated and was removed. The cavity which remained, opening widely into both the mouth and the nose, gradually contracted or was filled up, and the man recovered perfectly.

ENCHONDROMATA OR CARTILAGINOUS TUMOURS.

Cartilaginous tumours of bone are most frequently met with in the bones of the hand, somewhat less frequently in the contiguous ends of the femur and tibia, and still less frequently in other bones.

They commonly occur as one or more circumscribed spherical masses of cartilage in the interior of the bone, or as irregular, lobulated growths beneath the periosteum; in rare instances they grow both within and without the bone at the same time. They are composed either of a single mass of cartilage without visible partitions, or of numerous small clustered masses bound together by connective tissue and blood-vessels. They are usually exceedingly hard and firm, occasionally soft and compressible, generally of slow growth, and of small or moderate dimensions, but they may grow with great rapidity and attain a large size. They are nearly always innocent, simply displacing surrounding structures, not infiltrating them; in rare instances, however, secondary growths have been found in distant organs.

On section they appear translucent, bluish-grey or pinkish-white, homogeneous or coarsely granular, and frequently mapped out into irregular lobules. The cartilage is usually of the hyaline variety, but all gradations between hyaline cartilage and mucoid tissue occur. In the rapidly growing tumours sarcomatous elements have also been found, the presence of which probably accounts for their occasional malignancy. They are liable to undergo ossification, calcification, mucoid and fatty degeneration; cysts are likewise frequently found in them. Exostoses surrounded by a layer of cartilage, although described as osteomata, are by many regarded as ossifying cartilaginous tumours.

The peculiarities presented by cartilaginous tumours occurring in different bones and in different situations in these bones may be studied under the following heads:

In the bones of the hand.

Cartilaginous tumours in the hand are always confined to the metacarpal bones and phalanges. They generally affect several fingers at the same time, and two tumours frequently occur in the same bone. They generally begin in the medulla near the articular ends. As they grow they expand the bone around them, and at length, perforating the bony shell, project as nodulated tumours upon its surface. The integument, at first tightly stretched over them, may subsequently ulcerate from their pressure. By the coalescence of several of these tumours large masses are sometimes formed in which two or more fingers become completely buried and indistinguishable from each other. When a single tumour occurs upon the bones of the hand it begins outside the bone, thus resembling those that grow about the articular ends of the long bones.

Cartilaginous tumours in the bones of the hand rarely undergo ossification; they more often undergo calcification. They nearly always occur in the young, are often congenital, generally of slow growth, and always innocent.

I. 283.—Sections of a little finger and of the metacarpal bone of the forefinger of a lad seventeen years old. The greater part of the cancellous tissue of the shaft of the metacarpal bone is filled with a minutely lobed, pale greyish mass of cartilage like that of the fetal skeleton, which also, projecting through an absorbed portion of the wall, forms an hemispherical tumour rising from the shaft. A similar growth of cartilage exists within, and projects in a tumour beyond the first phalanx of the little finger; but in this instance the wall of the bone is not penetrated by the cartilage, but has grown in a thin layer around it. A portion of the medullary tube of the second phalanx of this finger contains a similar growth of cartilage, but scarcely any external tumour or enlargement of the bone is observable.

The patient had on his left hand four and on his right hand six tumours such as these, but these alone were troublesome and increasing. The tumours had begun to grow when he was five years old, and their growth had been irregular, some increasing, while others remained stationary.

I. 284.—The right hand of a lad fourteen years old, in the bones of which are numerous cartilaginous tumours like those in the preceding specimen. In many of them are small scattered formations of cancellous bone with medulla; all of them appear to have grown within the several bones, expanding parts of their walls and periosteum into their osseous and fibrous investments.

I. 285.—The little finger of the left hand of the same patient. Part of its first phalanx is expanded around a large cartilaginous tumour, having the same general structure as those in the preceding specimen.

Half the tumour has been removed from the investment or shell of bone and periosteum extended round it.

The tumours had been growing without any known cause from early childhood till the hand and finger were amputated.

I. 286.—A man's right hand, with similar cartilaginous tumours. Two or three in the metacarpal bones project in round bosses in the palm; one or two are in the first phalanx of the thumb, and one of large size in the first phalanx of the forefinger or in the distal end of the metacarpal bone. The rest of the forefinger and the whole of the second finger are buried in a large spheroidal tumour nearly six inches in diameter, in which the walls of their phalanges are only just discernible. The outlines of the several distinct tumours, by the fusion of which, it may be presumed, this great mass was formed, cannot now be seen. In many interspaces among the nodules there is much scattered cancellous bone, with yellow well-formed medulla. Over the dorsal surface of the large tumour there was a deep ulcer (as shown in the next specimen); but with this exception the bones and all the other tissues surrounding the tumours appeared only extended by their growth.

I. 287.—A section of the largest cartilaginous tumour mentioned in the last description. It shows part of the ulcerated surface of the tumour. A deep excavation is formed in it. The surface exposed is formed by the substance of the tumour, scarcely altered in texture, and having no covering of granulations. In the recent state a thin layer of half-dried pus or imperfect cuticle covered it.

The patient from whom this and the preceding specimens were taken was a man fifty-six years old. The tumours had grown from his birth to the time of his attaining his full stature, and some of them were congenital. Besides these he had had a tumour of two pounds' weight in the forefinger of his left hand, which was removed when he was sixteen years old. A tumour as large as a walnut still remained on the little finger of the same hand. The whole length of his left tibia had nodules on its anterior and inner surface, and some enlargement existed on his left second toe. None of his relatives had similar disease.

In the articular ends of long bones.

Cartilaginous tumours of the articular ends of the long bones nearly always begin between the periosteum and the bone, and, although they border upon the articular cartilage, do not arise from or encroach upon it. Their general shape is spherical, and their composition like that of ordinary hyaline cartilage. They frequently contain sarcomatous elements. The layer of compact bone in contact with the tumour becomes eroded and cancellous, and ossification of the tumour then takes place in the form of osseous spicula growing out from the surface of the bone; ossification also begins in distinct centres in the mass of the tumour.

Cystic degeneration is common. These tumours often grow rapidly and attain a large size; the integuments over them are then apt to slough. They generally occur in the young.

I. 288.—Section of a tibia and of a large cartilaginous tumour surrounding its upper two thirds. The tumour is seated entirely between the bone and the extended periosteum; the continuity of the periosteum with the investment of the tumour is distinct at the lower part. At its upper part portions of cancellous bone are embedded in it, and portions of similar bone have grown into most of those parts of the tumour which are in contact with the surface of the tibia. A large cavity within the tumour is irregularly bounded by nodules of its cartilage and by a coarse network of fibrous bands, the remains of partitions between portions of the tumour, whose softening probably led to the formation of the cavity. All these tissues bounding the cavity appeared, in the recent state, soft, flocculent and sloughing, and it was filled with brownish-yellow, putrid, and decomposing fluid. The general shape of the tumour is spheroidal; its weight is twenty-four pounds.

The patient was a girl fourteen years old. The tumour had been growing eighteen months.

I. 22.—Section of a femur and of part of a large cartilaginous tumour which closely surrounds it. A section of the tumour with drawing is preserved in the Microscopical Cabinet (A. 1). The tumour had grown rapidly but without much pain; the patient recovered after amputation of the limb. A cast of the limb from which this tumour was taken—No. I.

I. 41.—Section of a tibia and of a large cartilaginous tumour which has formed around its upper third. One half the tumour, the vessels of which have freely received the injection, is of a soft, fleshy, vascular texture (probably sarcomatous). The internal part of the tibia is sound.

I. 25.—Section of a large tumour growing from the lower part of the femur, and composed of nodules of cartilage intermixed with osseous matter. Part of the morbid structure extends through the wall of the femur with which it is connected, and through the interior almost to the opposite side.

In the middle of the shaft of long bones.

Cartilaginous tumours in this situation are rare. They begin as distinct masses simultaneously within the medullary canal, and outside the shaft between the periosteum and the bone. As they enlarge, the bone between them becomes absorbed, and they finally coalesce into one large tumour. In structure they partake more of the character of the fibrous than of the ordinary hyaline cartilage.

I. 111.—Section of a femur with a large spheroidal tumour which has formed within and around it. In the upper part of the bone a fracture

occurred several years before death. The two portions of bone overlapping have firmly united. The tumour, which nearly surrounds the middle of the shaft, is composed of a firm substance like fibro-cartilage. A portion of the same substance occupies the corresponding part of the medullary cavity, in which the disease apparently also commenced.

The microscopical characters are those of fibro-cartilage. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 2).

I. 112.—The other half of the above specimen, dry.

In the cranial, facial, and pelvic bones, ribs, and vertebræ.

Cartilaginous tumours of these bones generally spring from the deeper layers of the periosteum. They have a remarkable tendency to spread in all directions, causing great destruction of adjacent parts.

In facial bones. XXXV. 47.—Section of a large tumour formed on the face of a lad fourteen years old. The greater part of it occupies the situation of the superior maxillary bones, which are completely absorbed. Above, the tumour has extended through the left side of the base of the skull into its cavity, where it forms a large projection in the situation of the anterior lobes of the cerebrum; below, it is united to the soft palate; in front, it protrudes and distends the left nostril, and has caused the ulceration of a part of the integuments of the face. The outer surface of the tumour is nodulated; its interior shown by the section, is formed of close-set nodules and masses of cartilage, partially and irregularly ossified, and in some parts intersected by layers of a softer, probably fibrous, tissue. A portion of its external surface, projecting below the left nostril, has sloughed.

In the pelvic bones. I. 118.—Section of a cartilaginous tumour which was connected with an os innominatum. The remaining part of it, consisting principally of bone, is in Sub-series A. 133.

In the ribs. I. 115.—A cartilaginous tumour springing from a rib and making its way into the chest and vertebral canal through the intervertebral foramen.

OSTEOID CHONDROMATA.

The term osteoid chondroma is applied to what appears to be a rapidly ossifying variety of enchondroma, viz. to firm, dense growths, consisting in great part of hard, chalk-like, ill-formed bone, surrounded by dense material of fibrous-like consistency. To outward appearance they cannot be distinguished from ossifying fibromata, sarcomata, or carcinomata, but on microscopical examination the unossified part of the tumour is seen to consist of what is called by Virchow "osteoid tissue," that is to say, of material resembling in structure decalcified bone, and similar to that formed between the periosteum and bone in rickets. It consists, like bone,

of trabeculæ and medullary spaces; the trabeculæ, however, do not contain bone-corpuscles, but angular cells, and the medullary spaces enclosed by the trabeculæ are filled with fibrous tissue and masses of cartilage in place of medulla. The deeper portions of the tumour are always calcified or ossified. (Cornil and Ranvier.)

These growths appear to spring from the periosteum and project around the bone, also to grow inwards, taking the place of the cancellous tissue and medulla. They often attain a large size, affect the neighbouring lymphatic glands, and are reproduced in distant organs. The secondary growths present all the characters of the primary tumour, consisting in great part of ill formed bone. They may grow with great rapidity, or slowly, extending over many years. They commonly occur in the contiguous ends of bones entering into the formation of the knee-joint, especially in the lower end of the femur.

Many of the tumours formerly called osteoid cancer appear to be osteoid chondromata. Indeed, "so many recurrent ossific tumours," say Drs. Wilks and Moxon, "have been recently found of this kind that it is doubtful whether most of the so-called osteoid cancers of authors were not really osteoid chondromata."

Billroth, on the other hand, maintains that the osteoid-chondromata always contain sarcomatous elements, and doubts whether they can be distinguished, even microscopically, from ossifying round-celled or spindle-celled sarcomata. Hence he does not separate them from the sarcomata.

I. 139.—Section of the head and upper part of the shaft of a tibia and of an osteoid growth around and within it. A dense osseous substance, as hard as ivory and dull white like chalk or pumice-stone, occupies the place of the cancellous texture and extends some way down the medullary cavity. The tumour around the bone consists in part of a similar osseous substance, and in part of a soft substance, spongy and cellular in some situations, and like a medullary tumour in others. A portion of the periosteum is separated to show that the morbid growth has originated beneath the membrane from the surface of the bone itself. The smaller tumour connected with one side of the morbid mass occupied the situation of the popliteal lymphatic glands and consists throughout of bone partly ivory-like and partly opaque.

Microscopically the soft parts of the tumour consist of "osteoid tissue," islets of cartilage, and fibrous tissue.

A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 3).

SARCOMATA.

Sarcomata of bone have the same structure as those of soft parts, viz. embryonic tissue in various stages of development. The three

varieties of sarcomata, the round-celled, the spindle-celled, and the myeloid, occur in bone, the two former generally in connection with the periosteum, the latter with the medulla. These varieties, however, may be modified, as in soft parts, by the admixture of fibrous tissue, cartilage, mucous tissue, pigment or bone; and, according as these several tissues predominate, the tumour is designated fibro-, chondro-, myxo-, melanotic- or osteo-sarcoma; when cysts are developed, cystic-sarcoma. Some of these will be more particularly referred to below.

THE ROUND-CELLED SARCOMATA.

The round-celled sarcomata may be divided into the periosteal and the endosteal, according as they begin in the periosteum or the medulla. The former, which are by far the more common, in their early stages are situated between the periosteum and the bone. They appear to spring from the deeper layers of the periosteum, and as they increase in size carry the superficial layers before them, and at length, perforating them, make their way into the connective tissue between the muscles and other adjacent soft parts. At the same time they generally invade the bone, infiltrating and dilating the Haversian canals, and so converting the compact tissue into cancellous. Occasionally, however, they merely indent, but do not infiltrate the bone. In appearance they are whitish or cream coloured, often blotched with red from rupture of their vessels and extravasation of blood; yellow patches are also seen here and there, due either to fatty degeneration of the sarcomatous elements or to the breaking down of blood-clots. If these changes proceed further, cysts may be formed; these cysts are at times lined with pseudo-epithelium.

In consistency the tumours are either tough, hard, and fibrous, or soft, gelatinous, and brain-like, but they may present all gradations between these conditions. When scraped they do not yield a milky juice. They are more rapid in their growth than either the spindle or the myeloid form, and are generally softer. A microscopical examination, however, is necessary to distinguish the round from the spindle-celled, or either from periosteal cancers. In sarcomata the neighbouring glands are not usually affected. Frequently both round and spindle cells are found in the same tumour. When these tumours undergo calcification or ossification the earthy particles may proceed both from the periosteum and the surface of the bone. Ossification more generally occurs in those of slow, calcification in those of rapid growth; the ossific deposit resembles imperfectly formed bone. The round-celled are generally the most malignant of the sarcomata.

THE SPINDLE-CELLED SARCOMATA.

These, like the round-celled variety, occur both periosteally and endosteally, but periosteally with far the greater frequency. What has already been said with regard to the round-celled sarcomata is applicable to the spindle-celled. The latter, however, are generally firmer and more fibrous, of slower growth, and less malignant.

I. 363.—A section of a large spindle-cell sarcoma which originated in the upper third of the right fibula of a man aged twenty. The disease was only of four months' duration.

I. 116.—Section of a tumour and of part of a tibia. The tumour occupies the situation of the head and the upper third of the shaft of the tibia: it apparently originated in the interior of the bone, and extended the wall around it as it grew. At the upper part, the articular surfaces of the tibia and the ligamentum patellæ may be recognised. The tumour consists in part of a white, solid, and very firm substance, and in part of a more vascular and spongy substance, in which there are large cysts that were filled by a gelatinous fluid. From a man, aged forty. The limb was removed by operation. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 4).

I. 97.—Section of a femur and of a tumour surrounding the lower part of its shaft. The tumour consists principally of spindle cells intermixed with fibro-cartilage, with spicula of bone dispersed through it. At its posterior part are some thick-walled membranous cysts which were filled with coagulated blood. The injection of the limb has displayed minute vessels distributed irregularly through the tumour. The walls of the femur enclosed within the tumour are diseased, softened, and thinned, to the extent of about two inches, and in this situation the shaft is broken, and the cancellous tissue is filled by a morbid structure similar to that which surrounds the bone. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 5).

I. 98.—Section of the tumour last described. The patient was twenty-two years old, an opera-dancer, and the disease had existed about seven months. The tumour grew rapidly and with much pain. He died shortly after amputation of the limb, and no other part was found diseased.

THE MYELOID SARCOMATA.

The myeloid sarcomata, or myeloid tumours of Paget, so called because their minute structure resembles that of marrow, nearly always begin in the medulla, rarely between the periosteum and the bone. Their favourite seats are the articular ends of long bones and the upper and lower jaws. When they begin in the medulla they expand the bone around them, often rendering it so thin that it gives the sensation of egg-shell-like crackling to the touch; or they completely destroy it in places, so that they are

covered only by the periosteum. They are usually of an ovoid or spheroidal shape, or more rarely, as when they begin between the periosteum and the bone, irregular and lobed. They vary from a firm or fleshy to a soft or jelly-like consistency. They are neither elastic nor tough. On section they appear uniformly smooth, succulent, shining, semitranslucent, but not fibrillated. In colour they vary from greenish-white to livid crimson blotched with brighter patches of pink or darker red. They are soft and dry, not yielding any milky juice like cancers. Although usually but moderately vascular, they sometimes pulsate, this pulsation being communicated to them by the arteries of the bone in which they lie. Masses of cartilage are frequently found in them, but ossification is rare. Cysts also occur with great frequency, and often attain a large size. They are generally of slow growth and non-malignant; after removal, however, they have been followed by the more malignant forms of sarcomata.

Under the microscope a number of large, many-nucleated cells (myeloid) are seen scattered through a basis substance which is composed in great part of spindle cells and of a fewer number of small round cells.

Myeloid tumours in the ends of long bones.

The ends of the bones, forming the knee-joint are those most frequently affected, and of these the lower end of the femur rather than the upper end of the tibia. Beginning in the cancellous tissue the tumour expands the bone around it, destroying the lamellæ and so hollowing out the articular end into a thin-walled cyst. In some instances however, more or fewer of the lamellæ may escape destruction, and then the cyst-like expansion has a multilocular appearance. By the older pathologists the former condition was called "*Spina ventosa*," the latter "*malignant exostosis*;" these terms are, however, almost obsolete. Sooner or later the expanded bone gives way, and the tumour, thus released from the restraining influence of its bony case, sprouts out into the soft tissues, where it grows with increased rapidity, and finally reaching the skin sets up ulceration and protrudes in the form of a fungous mass.

The articular cartilage is seldom involved in the disease, but appears sunken, as it were, into the substance of the tumour, a condition in part due to the growing up of the sarcomata around the cartilage, and in part to the actual sinking of the cartilage from the yielding of the tumour to the superincumbent weight of the body, the supporting bony trabeculæ having been destroyed.

Mucoid degeneration and hæmorrhages, leading to the formation of cysts, are common, but calcification and ossification is rare.

I. 298.—Section of the upper part of a tibia, within the head of which a nearly spherical tumour, about four inches in diameter, has grown. The greater part of the substance of the bone has wasted during the growth of the tumour, round which its remains are extended in a thin cyst of bone and periosteum. The articular surface is unchanged, but almost all of the layer of bone beneath the cartilage is absorbed. The chief part of the tumour consists of close-set thin-walled cysts, the cavities of which were filled with bloody fluid. Other parts around and between the cysts consist of soft, opaque-white brownish and yellow substance, variously tinged with blood. A few bands and thin plates of bone traverse the space thus filled with cysts and solid growth. The upper part of the shaft of the tibia immediately below the part which is extended round the growth appears to be healthy.

The microscopic structures in the solid parts of the tumour, and in the walls of many of the cysts, were chiefly many-nucleated cells, like those characteristic of myeloid tumours.

The patient was a woman twenty-four years old. The first sign of the disease was severe pain in the head of the tibia. This was observed eighteen months before the removal of the limb, and after it had existed ten months swelling appeared. The swelling rapidly increased, the pain rather diminished, but the limb became constantly more feeble and unequal to support the body. Recovery followed amputation.

I. 289.—Sections of the lower part of a fibula with the tibia and astragalus. The walls and periosteum of the lower end of the fibula, including the malleolus, are extended into a thin osseous and fibrous capsule by the internal growth of a myeloid tumour.

The tumour contained much cartilage, grew slowly, and pulsed distinctly.

I. 46.—A section of the lower part of a femur, and of a brain-like myeloid tumour which has grown within the condyles and has extended them into a large, thin-walled, osseous and fibrous cyst. The tumour projects chiefly backwards and laterally. A part of it is covered by the articular cartilage of the femur, which is extended over it, and in the middle between the condyles is perforated by the morbid growth penetrating into the knee-joint in front of the crucial ligaments. (Such a perforation of the joint is rare.) A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 6).

I. 83.—A section of the upper part of a tibia, and of a large myeloid tumour which has formed within it. The tumour consists partly of a soft, brown, fibrous-looking substance, and partly of coagulated blood; and there are some small cysts in it. A thin crust of the expanded walls of the bone surround the tumour. Upon the upper part of the tumour, in the articular surface of the tibia, there is a deep

excavation, which lodged one of the condyles of the femur. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 7).

I. 212.—Section of the lower end of a femur, in which nearly all the cancellous tissue within the condyles and for a short distance up the shaft is removed, and its place is occupied by a myeloid tumour. The greater part of the tumour is nearly white, but there are many spots in it of a deep red colour from effused blood, and at the upper part is a section of a small cavity—a cyst in process of formation—which was filled by a soft gelatinous material. The gelatinous material was probably a portion of the tumour undergoing mucoid degeneration. The growth of the mass has expanded the internal condyle and the posterior part of the femur into a large round sac, of which the walls are partly formed by the articular cartilage and the periosteum. The patient was a man twenty-seven years old; the disease had existed twelve months with obscure symptoms, and made steady progress till the limb was amputated. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 8).

I. 220. Portion of a femur, of which the lower extremity is expanded into a large cyst, which was filled by liquid and coagulated blood and a small quantity of brain-like substance. Below, the cyst is bounded by the articular cartilage, of which the texture is unaltered; above, by the shaft of the femur, which terminates abruptly just before it is expanded into the cyst.

From a gentleman, thirty years of age, in whom the tumour had been two years in progress. Four years after the amputation of the limb he was in good health.

I. 49.—Sections of the upper half of a humerus, and of a myeloid tumour which occupies the place of the shaft of the bone. In one of the sections a small portion of the diseased structure, distinct from the general mass, has protruded through the walls of the bone. In the other section the morbid structure is covered by the articular cartilage which belonged to the head of the bone.

The tumour in this instance had a constant and regular pulsation, the cause of which was not discerned in the examination of the limb. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 9).

I. 159.—Section of the lower part of a tibia and of a tumour contained within it. The tumour consists of a brain-like medullary substance with blotches of blood effused in it, and is almost completely surrounded by a thick osseous cyst, which is continuous with the wall of the tibia. The arteries of the limb are injected; some of their branches pass through the morbid growth. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 10).

I. 160.—The other half of the tibia and of the tumour last described. A portion of the skin is here left, in which there is ulceration with fungous growth originating in the morbid structure. The cavity immediately above the cartilage of the ankle-joint was filled by soft medullary substance.

Myeloid tumour of the jaws.

I. 273.—Section of the anterior part of a lower jaw and of a myeloid tumour formed within it.

I. 274.—Myeloid tumour of upper jaw.

Other specimens of myeloid tumours will be found described in the section on diseases of the jaws.

Myeloid tumour of skull.

I. 293.—Portion of the upper part of a boy's skull and of a great myeloid tumour involving it and pressing inwards upon the brain. The section was made transversely from ear to ear through the skull tumour, and brain.

I. 294.—The other half of the specimen I. 293.

Spindle-celled sarcoma following the removal of a myeloid sarcoma.

I. 304.—The head of the humerus (absent from this preparation) presented an example of myeloid tumour, about the size of an infant's head, and in most parts encapsulated by a thin layer of expanded bone. In some parts, however, only the periosteum existed, and, in others, even that had given way. The adjacent muscle was involved, especially where the deltoid muscle adhered to the growth.

The parts preserved were obtained from a woman aged thirty-three, who, six years before her death, was supposed to have sustained a fracture or dislocation of the head of the humerus. To this succeeded permanent loss of motion, and gradual enlargement about the part. This growth was spontaneously arrested during four years. Subsequently resection of the upper part of the humerus, of the tumour, and of some diseased glands was resorted to. The operation was recovered from, but the disease was rapidly reproduced in four different situations. She died four months after the section, from an enormous mass of sloughing and bleeding sarcoma, connected with the bone, the axilla, and the adjacent glands. The shortening of the humerus in the preparation is due to the above-mentioned removal of its upper third. Its shaft is healthy, and is united to the lower edge of the glenoid cavity by a thick ligamentous band permitting of free motion. A large growth springs from and surrounds the periosteum of the shaft at the point of section. This, unlike the tumour previously described, has the structure of a spindle-celled sarcoma. A section of the growth with drawing is preserved in the Microscopical Cabinet (A. 11).

OSTEO-SARCOMATA.

The sarcomata, as has already been incidentally remarked, like other tumours of bone, are liable to undergo ossification and calcification. When much earthy matter is "deposited" in them they are called osteo-sarcomata. They are generally of the round or spindle-celled variety. The ossifying periosteal sarcomata resemble

in outward appearance the tumours already described as osteoid chondromata, which latter, as we have seen, Billroth does not recognise as a distinct class of tumours. Many of the growths formerly called osteoid cancer were probably osteo-sarcomata.

I. 269.—Section of a femur, of which the lower half is surrounded by an osteoid tumour. The tumour extended around the whole circumference of the femur. It has an elongated form, is thin where it abuts on the articular margin of the bone, but in the rest of its extent rises to between two and three inches from the surface of the shaft. The periosteum appears to be involved in the tumour, and the popliteal artery and vein run through it near its surface. The walls of the femur appear thickened and hardened, and large portions of morbid substance, like that which forms the tumour external to the walls, exist in the cancellous tissue and medullary tube. The greater part of the substance of the growth, both without and within the walls of the bone, consists of a very firm, dense, and compact tissue, pale yellowish, and obscurely fibrous; that part which is attached to the femur is chiefly osseous, its tissue having peculiarities which are better shown in the next following specimen. The outer surface of the tumour is unequal and knobbed, and a few portions of similar substance lie adjacent to, but distinct from, the chief mass. Microscopically the tumour appears to be of the nature of an ossifying round-celled sarcoma intermixed with fibrous tissue and cartilage. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 12).

I. 270.—The other section of the same femur dried after maceration. The osseous parts of the tumour appear as irregular outgrowths from the femur, and as deposits on its surface. On their surface they are brittle, lamellar and in parts like pumice; more deeply, the chief growths are hard, very compact, and ivory-like. Similar formations of hard bone occupy a portion of the cancellous tissue of the shaft, and its walls in the corresponding structure are similarly hard and ivory-like. In other parts the walls of the shaft are more porous than is natural, as if they had been abnormally vascular.

I. 271.—Section of the upper third of the same femur. In the cancellous tissue near its great trochanter there is a small circumscribed mass of fibrous-looking substance like that of which the greater part of the tumour in I. 269 is composed.

I. 272.—Section of a mass of inguinal lymphatic glands from the same patient as the three preceding specimens. They are greatly enlarged and their proper tissue is replaced by a very firm and compact pale substance, which is, in part, obscurely fibrous, and altogether resembles very closely the principal mass of the tumour round the femur. The femoral artery and vein pass through the middle of the disease.

The four preceding specimens were taken from a man forty-five years old, of unhealthy aspect. The tumour round the femur had been observed for five months, and was so painful that he solicited the removal of his limb, though dissuaded on account of the disease in

his inguinal glands. He lived two months after the amputation, and, in addition to those shown in I. 272, masses of substance resembling the tumour round the femur were found in the place of other inguinal and lumbar glands, and in the lungs. In many instances these masses contained osseous as well as the apparently fibrous tissue.

I. 295.—Section of the lower half of a femur surrounded and filled with ossifying spindle-celled sarcoma. The whole circumference of the shaft, between the periosteum and its walls, is enveloped by the sarcomatous substance, which in a layer from half an inch to nearly two inches in thickness forms a large firm tumour of elongated oval shape. The general or basis substance of the sarcoma is almost pure white, very firm, and compact, but in the parts nearer to the bone it is extensively osseous, and the greater part of the bone within it appears to have extended into it from the surface of the shaft on which it rests. In the same extent to which the femur is thus surrounded with sarcoma its medullary canal is filled with hard, white, and finely porous bone, formed apparently by the almost complete ossification of sarcomatous substance. Between the laminae of the walls, also, similar substance exists, separating them, and at the lower part so displacing them that the morbid structure around and within the shaft are combined in a continuous mass. The epiphysis is healthy.

The microscopic structure of the soft parts of the tumour is that of a spindle-celled sarcoma. The osseous substance was in both situations true bone with well-formed lacunae. The patient was a girl twelve years old. A section of the tumour with drawing is preserved in the Microscopical Cabinet (A 13).

I. 364.—A large mixed sarcoma, of three or four months' duration, springing from the periosteum of the middle and upper third of the femur, and involving the structures immediately surrounding it. From a boy, aged thirteen. The limb was removed by amputation at the hip-joint. The patient made a good recovery from the operation, and left the hospital about two months afterwards. He was reported, however, about a year after the operation, as dying with local recurrence of the growth. Secondary caries of the bone is to be seen where the periosteum has become detached. Microscopic examination showed the tumour to be composed of connective tissue of all varieties and in all stages of development, viz. small nucleated round and spindle cells, well-formed fibrous tissue, cartilage cells, and in places bony spicula, springing from the periosteum and passing outwards into the soft substance of the growth.

I. 61.—Sections of a fibula, upon the external surface of which are several osseous tumours, masses of compact, white, osseous substance, the outer surfaces of which present a fasciculated and finely fibrous aspect, like the surface of pumice-stone. Around these the walls of the bone are in parts superficially ulcerated, and in parts thinly covered by new bone. The medullary cavity is partially obliterated by a similar substance.

I. 108.—A section of the lower half of a femur, and of an osteo-

sarcoma which has formed around it. The tumour consists almost entirely of a solid, uniform, and very dense osseous substance. The medullary tissue of nearly all that part of the bone which is surrounded by the tumour is filled by a similar substance, and about the condyles, the walls of the femur being absorbed, the morbid growths within and without form one mass. A part of the exterior of the tumour is composed of a soft substance. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 14).

I. 109.—The other section of the femur and osteoid tumour last described. By maceration the soft matter of the tumour has been removed, leaving only the hard, dense, and white osseous substance around and within the bone. The outer surface of this portion of the tumour is nodulated, and portions of it have a fibrous texture like that of pumice-stone. In the lower part of the bottle are several of the inguinal glands and lumbar lymphatic glands from the same side of the body as the tumour. They are converted into an osseous substance similar to that of which the tumour is composed.

I. 110.—The femoral artery, together with several bony tumours which occupied the situation of the lymphatic glands in the ham and groin of the patient from whom the two preceeding specimens were taken. The tumours consist of a hard osseous substance, which is displayed by a section of one of them. The femoral artery is sound, but its popliteal portion is compressed and altered in its course by its connection with the bony tumour. The ligature upon the artery, about three inches below the origin of the profunda, was placed around it in consequence of the tumour in the ham having a pulsation and other characters like those of an aneurism. The patient was a man, thirty years old. A section of one of the tumours with drawing is contained in the Microscopical Cabinet (A. 15).

MELANOTIC SARCOMATA.

Melanotic or pigmented sarcomata are rare in the bones. The three following specimens are probably examples.

I. 190.—Sections of lumbar vertebrae with melanotic sarcomata (P) scattered through the cancellous texture of their bodies.

I. 191.—Sections of a rib with melanotic matter in its interior.

I. 192.—Portions of a parietal and a frontal bone, displaying the deposition of melanotic matter in the diploë. In all these specimens the melanotic matter is deposited in circumscribed spots, like so much black pigment, in the bones. It does not form tumours, nor does the tissue of the bone in which it lies appear at all altered.

The three preceding specimens were taken from a woman in whom melanotic matter was abundantly found in various parts of the body—the lungs, liver, ovaries, mammary gland, dura mater, and others.

CANCER.

Cancer in bone is less common than was formerly supposed; re-

cent microscopical examination has shown that many growths in bone once considered cancerous have a sarcomatous structure. Clinically, however, this anatomical distinction is unimportant, as both cancer and sarcoma are equally malignant. All four varieties of cancer occur in bone.

MEDULLARY CANCER.

The medullary or encephaloid is the most common variety of cancer in bone. It bears a general resemblance to medullary cancer of other parts, being generally soft and brain-like, or harder and more fibrous, of a creamy-white colour and blotched in places with red. Ossific spicula and cysts are often found in its substance, and will be more particularly referred to afterwards.

It may be either primary, or secondary to cancer of other organs. Three forms are described, the periosteal, the nodular or tuberos, and the infiltrating.

The periosteal variety.

The periosteal variety springs from the deeper layers of the periosteum, and as it increases in size raises up the outermost layers of that membrane before it, and at the same time invades the bone by making its way into the Haversian canals.

In appearance the tumour is commonly irregularly spindle-shaped, embracing the whole or greater part of the circumference of the bone. On section fibrous bands, the remains of the infiltrated periosteum, are seen stretching through the tumour from the periosteum to the bone. Periosteal cancers are very prone to undergo calcification and ossification, the calcareous or osseous spicula making their way into the tumour from the bone.

I. 279.—Section of a tibia and of a firm, white, medullary cancer, which covers a large portion of the anterior surface, and nearly encompasses the rest of the shaft, and from which portions extending through the front wall are continuous with a similar growth occupying the medullary tube and protruding through the posterior wall. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 16).

I. 170.—Section of a femur, with the osseous part of a tumour which occupied the place of the shaft of the bone. The tumour measured thirty-six inches in circumference. Its outer part consisted of medullary substance; the deeper, of a mixture of medullary substance and bone. The head of the femur is the only portion of the bone retaining

its healthy structure. The morbid osseous substance is fragile, light, spongy, and cancellous; but the form of the cancellous spaces differs materially from that of those in healthy bone. From a girl, aged eleven years.

I. 171.—Sections of the femur last described.

I. 365.—A section of the sternal end of the left clavicle and of a medullary carcinoma which grew from it. The tumour had been observed for nine months, during the first six increasing gradually, and the last three rapidly.

The parts were removed by operation during life, and the patient made a good recovery. When he left the hospital he was able to use the arm well.

The tuberos variety.

The tuberos or interstitial variety occurs in isolated masses in the substance of the bone itself; it is rare. Most of the tumours in the interior of the bone, called in the Catalogue medullary, have the minute structure of myeloid sarcomata.

In the articular ends of long bones.—I. 356.—The lower end of a femur, with contiguous soft parts occupied by a soft cancerous tumour containing a large cyst. Immediately above the condyles the bone has been almost completely absorbed, its continuity being preserved only by a small portion of the outer part of the shaft.

From a woman, aged thirty-six, in whom the disease had existed for ten months.

I. 84.—A section of the lower part of a femur, the cancellous tissue of which is filled by a pale brownish, flocculent, and shreddy medullary substance. The walls of the bone and the cartilage are sound, except at the posterior part of one of the condyles, where they are absorbed, and the morbid growth protruding from within the bone is connected with several similar medullary tumours formed around the bone. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 17).

In the shafts of the long bones.—The tuberos variety is less common in the shafts than in the articular ends of the long bones. Shafts so affected are very liable to spontaneous fracture.

I. 223.—Section of a clavicle, in the interior of which a firm medullary substance has been deposited in large quantities. The posterior wall is but little changed, but the greater part of the anterior wall is lost in the interior of the tumour which grew to a great extent forwards. The shaft was fractured (with only a slight force), and its portions are widely displaced without any attempt at union.

I. 224.—The other section of the same clavicle after maceration. It shows more distinctly the characters of the osseous structure into which the anterior wall of the bone, which was chiefly involved in the growth, was changed.

From a man sixty years old. Four years before death, the growth had the aspect of a small tumour growing within and expanding the walls of the clavicle. After this, enormous masses of a similar medullary substance formed around the clavicle and in the subcutaneous tissue and other parts of the body.

The infiltrating variety.

In this variety the periosteum, the compact wall, and the cancelli, are simultaneously infiltrated by the cancer. Extreme cases of infiltration lead to the softening of the bone in consequence of the destruction of the lamellæ, and have been described as a form of mollities ossium. Bones thus affected are very liable to spontaneous fracture.

In the shafts of the long bones. I. 230.—The upper half of a femur, round a portion of which a thin, flat, nodulated, medullary growth, of a soft, spongy, and obscurely-fibrous texture formed. The shaft at the part enclosed by the diseased structure was broken by a slight force. Its texture at this part appears soft, and is perforated by many small apertures.

From a woman, forty-three years old, whose right breast had been removed, with a medullary tumour in it, three months before death. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 18).

I. 250. Section of a humerus, around the middle of the shaft of which a firm, obscurely fibrous, medullary tumour has formed. Within the tumour the texture of the humerus, apparently infiltrated with medullary matter, is soft and brittle, and was broken during life by a slight force. The disease extends for a short distance into the medullary canal above and below the fracture, and a small round mass of cancer like that investing the shaft, is embedded on the inner surface of the wall. From an old lady who had suffered for some months from pains like those of rheumatism in the arm. She died shortly after the fracture of the humerus. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 19).

In the ribs. I. 203.—Section of a tumour occupying parts of the seventh, eighth, and ninth ribs of the left side. The tumour is composed of a highly vascular medullary substance, in which there are some cysts that were filled with serous fluid, and a few small masses of coagulated blood. The osseous substance of the ribs appeared to be expanded within the tumour, which in several parts presented small points of bone. The cartilage of one of the ribs is completely surrounded by the morbid structure, but is itself unaltered. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 20).

Sub-series A. 161.—A fibula and tibia. The former rough and irregular from deposits of new bone upon its surface; the latter light and porous, compact tissue being absent except at the articular surfaces. It was infiltrated throughout with medullary cancer, which had

caused in parts complete absorption of large masses of bone, and, just below the head, had destroyed the whole thickness of the shaft.

In the pelvic bones.—Cancer of the pelvic bones is classed under the infiltrating variety, as it appears to begin in the substance of the bone and at both surfaces at the same time. Pulsation is very common in these tumours of the pelvic bones, and has caused them to be mistaken for aneurism of the pelvic arteries.

I. 235.—Section of an ilium and of a medullary tumour covering a large extent of both its surfaces and extending through its substance. The tumour is of oval form, and reaches from the crest of the ilium to near the margin of the acetabulum. It is composed of a soft, spongy, and flocculent, reddish medullary substance, in which a few small cysts are scattered. It is covered in by the thickened periosteum of the ilium. At its centre the substance of the ilium is irregularly broken and absorbed, so that here the tumours on each side of the bone are connected into one mass by the morbid substance diffused through its texture. Portions of the iliacus and gluteus medius muscles are left connected with the periosteum, over which they were spread out in the growth of the tumour.

I. 236.—Another section of the same parts. A portion of the tumour has been so removed as to show the surface of the wall of the ilium on which it rested, parts of which are absorbed in minute round holes and irregular spaces, through which the growth without appears to dip in, and be connected with that within the ilium.

I. 237.—Another section of the same ilium macerated, to show the same partial absorption of its walls, and the other changes which it has undergone by the growth of the tumour.

I. 238.—Portion of the periosteum of the same ilium, with fragments of the medullary tumour held together by fibrous bands and cords and blood-vessels. These pass from the inner surface of the periosteum, intersecting the substance of the tumour.

I. 239.—A medullary tumour, removed from the arm of the patient, from whom the four preceding specimens were taken. It is of elongated oval form, soft and spongy in its texture, and has a few cysts scattered through it. Its proper colour is pale, and nearly white, but it is blotched with many spots of vascularity and effused blood. It is invested by a thin fibro-cellular capsule, with which a part of the brachial artery and median nerve are closely connected. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 21).

In the cranial bones.—It is difficult to pronounce an opinion as to the precise origin of medullary tumours when they involve the cranial bones, as in the stage in which they are usually seen they appear in the diploë, on both surfaces of the skull, and adherent to the dura mater. They are generally supposed to begin simultaneously in all three situations, and are therefore regarded as belong-

ing to the infiltrating variety. By some, however, they are believed to begin in the diploë, and afterwards to perforate both tables and become adherent to the dura mater; by others to begin in the dura mater and afterwards to perforate the skull. The former belief is founded upon the greater destruction of the diploë than of either table, and upon the convex lens-like shape of the internal as well as of the external surface of the tumour; the latter upon the fact that in some instances they are found only upon the surface of the dura mater. It is probable that they may begin in any of the above-mentioned ways.

Ossification is common in the deeper parts of these tumours, the osseous spicula projecting at right angles from the skull.

I. 248.—Section of a frontal bone, with numerous lens-shaped tumours of various sizes, from a line to two inches in diameter, thickly scattered through its substance. They grow from both surfaces, and from the substance of both tables; there were also several in other parts of the skull, and some on the dura mater. The tumours consist of a soft medullary matter, and in many of them delicate osseous fibres, standing vertically on the surface of the skull, are embedded. In the situation of the largest tumour, parts of which grow from corresponding portions of both tables of the skull, a similar medullary substance is diffused through the diploë. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 22).

I. 249.—Another section of the same frontal bone macerated, and showing more plainly the osseous portion of one of the tumours, and the altered state of the diploë where the medullary matter was deposited.

Sub-series A. 79.—Portion of the skull described in I. 248 and 249, upon and within which medullary tumours grew.

Sub-series A. 74.—A skull-cap, in which are many large ulcerated holes, occasioned by tumours originating in the dura mater. As in Sub-series A. 64, the edges of the holes are abrupt, rough, and sharp, and the loss of substance in the diploë is a little greater than in either of the tables. Ulceration has also in one situation commenced on the exterior of the frontal bone. The grooves for the meningeal arteries, which were doubtless enlarged for the supply of blood to the tumours, are very deep, though the skull is not thickened nor otherwise diseased, except in the parts involved by the tumours.

Sub-series A. 83.—A skull-cap, exhibiting ulceration of its outer and inner tables in numerous minute holes, of which many are distinct in close-set groups, but more have coalesced. There were fungous excrescences filling these minute excavations in the bones, some of which were attached to the pericranium, and others to the dura mater.

In the bones of the face. I. 225.—Part of the skull, of a man about forty years old, who had a large malignant tumour of the face. The tumour appears to have originated at the nasal process of the left superior maxillary bone and at the left nasal bone, upon which there is

a projecting growth of processes and plates of bone. The tumour, extending from this centre, produced absorption of the inner and lower part of the left orbit, the inner and anterior part of the right orbit, the septum of the nose, the turbinated bones, and the middle and posterior parts of the palate. To a slight degree also it destroyed the left cribriform plate of the ethmoid bone, and the adjacent part of the upper wall of the orbit. At nearly all the parts of the bones upon which the tumour encroached there is a thin everted border of bone.

SCIRRHOUS OR HARD CANCER.

Scirrhus cancer in bone is rare; it may occur either as a primary or secondary affection.

Primary scirrhus.

As a primary affection scirrhus cancer occurs as a firm dense growth surrounding and infiltrating the bone, and is generally in great part ossified. It cannot be distinguished by the naked eye from the growths already described as osteoid chondromata and osteo-sarcomata (see pages 58 and 66), which growths were formerly classed with it under the name of osteoid cancer.

Microscopically it presents all the characters of well-marked scirrhus cancer, such as occurs in the breast.

I. 324.—A longitudinal section of an "osteoid tumour," involving the lower two thirds of the left femur. It was removed from a seaman, aged forty-five, in whom it had existed for five years. During the last six months previous to amputation it had rapidly increased.

The surface of the tumour was of a pale buff colour, firm but could be cut with a knife, but a few lines below this it passed into compact bone. The section displays the continuity of the tumour with the femur. The minute structure of the tumour was that of well-marked scirrhus cancer. (Savory.)

I. 325.—The opposite section of the same tumour macerated and dried.

I. 358.—Specimen of ossifying scirrhus cancer of the lower end of the humerus, from a man aged forty-two. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 23).

I. 362.—Specimen of osteoid tumour of the lower end of the femur. Secondary deposits having the same characters as those of the tumour were found in the left pleura. The minute structure of the tumour is that of well-marked scirrhus cancer. A section with drawing is preserved in the Microscopical Cabinet (A. 24).

Secondary scirrhus.

As a secondary affection, scirrhus cancer in bone assumes two forms, the infiltrating and the nodular. In the former the cancer is disseminated through the cancellous tissue and compact walls of the bone, and as it grows expands the lamellæ and converts the bone into a fine network of bony plates or spicula.

The nodular variety occurs in distinctly circumscribed, round or oval masses, which, as they enlarge, destroy and ultimately make their way through the wall of the bone. Whether nodular or infiltrating in form, the cancer appears hard, grey, and shining, markedly resembling scirrhus of the breast. Fractures of bones thus affected are common; the callus produced for their repair is composed of cancerous elements.

The infiltrating variety.

Appendix b. 5.—The upper part of a femur, in which an oblique fracture, about an inch below the lesser trochanter, has united with an angular deformity, the superior portion lying behind and across the inferior one. In the upper portion, in the place of the natural structure of the walls of the femur, there is only a fine network of bony plates and fibres; and the osseous part of the medullary portion is formed of fine spongy and porous bone. The same change has taken place, in a less degree, in the lower portion. The diseased portions of bone, as well as the bond of union of the fracture, were filled, as if infiltrated, with tough, grey, cancerous matter.

The patient was a woman forty-seven years old. Two years before death her breast was removed on account of hard cancer. Sixteen months afterwards, when the disease in the breast had returned and ulcerated, in stepping from a cabriolet, she fractured her femur. The fracture was united in six weeks, but she did not regain the use of the limb. She died eight months after the fracture with extension of the cancerous disease of the breast.

IV. 39.—Section of seven dorsal vertebræ, from a man who died with scirrhus cancer of the breast and other organs. Five of these vertebræ are affected with scirrhus cancer. In the first and last two the cancellous tissue is filled, and in great measure displaced, by firm greyish substance, which had exactly the same characters as the cancer of the breast. Of the two middle vertebræ nothing remains but fragments infiltrated with cancerous substance, and enclosed in a cavity which was filled with other detached fragments and softened cancer. The intervertebral substance between these two vertebræ is disorganised, and its remains lie in the cavity with their fragments; the corresponding substances between the vertebræ above and below are softened at their centres.

The nodular variety.

I. 290.—Sections of the humerus of a man who died with scirrhus cancer of the mammary gland. Large portions of the medullary cavity are filled with a compact, very firm, greyish substance, like that of the common form of scirrhus cancer. Where this substance is the medulla and the cancellous bone of the interior of the humerus have completely disappeared. The walls of the bone are also in some parts thinned, and in some parts destroyed and penetrated by the cancerous

substance growing within them. The bone immediately bounding the cancerous substance appears healthy, and the borders of all the cancerous masses are well defined.

The patient was a strong, muscular man, in whom a hard cancer of the breast appeared twelve months before death. In the last two months of his life both humeri were fractured by slight forces. Cancerous disease, like that here shown, existed in the sternum and in several dorsal vertebræ preserved in IV. 39. A section of the tumour with drawing is contained in the Microscopical Cabinet (A. 25).

I. 292.—Part of the skull of a man who died of scirrhus cancer of the breast. The place of the right ala of the sphenoid bone and of small portions of the bone adjacent to it is occupied by hard, grey, cancerous substance, which nearly retains the shape of the bone that it has involved. Similar cancerous substances cover with a thin, granulated layer parts of both surfaces of the dura mater, the tissues of which appear similarly diseased.

EPITHELIAL CANCER.

It is doubtful whether primary epithelial cancer of bone ever occurs; secondary growths, however, due to the extension of the disease from the soft parts to the bone, are not uncommon. The cancer, commonly the result of long-continued ulceration of the soft parts or irritation of a sequestrum, invades the bone through the Haversian canals, dilating the medullary spaces and reducing the trabeculæ to irregular spicula of bone, which afterwards appear embedded in the substance of the cancerous mass. The cutaneous surface of the growth either appears as a sprouting fungous or as a cavernous ulcer, emitting a foul discharge.

Epithelioma of bone, like epithelioma of other parts, does not affect distant organs.

I. 29.—Section of a tibia, with the soft parts covering it, exhibiting the effects of epitheliomatous ulceration. The section was made longitudinally through the middle of the tibia; the other half of the tibia and the fibula are in the next preparation. By viewing the two preparations together, it will be seen that the ulcerative process has extended completely through the body of the tibia, in a great part of its length, and has reached the fibula, as is evinced by the peculiar excavated appearance of its surface. No attempt has been made to restore the lost bone: there is merely a slight deposit of bony matter upon the surface of the fibula, opposite to that which is in progress of ulceration. The interosseous ligament is in part converted into bone. The integuments around the hollow which has been left by the ulceration are much changed in structure; they are swollen, and the margins of the hollow are formed by very vascular, coarse, and hard, warty granulations.

I. 30.—Macerated portions of the tibia and fibula referred to in the preceding description.

They were taken from a man fifty-three years old. Thirty years before the amputation of the limb, a heavy piece of timber fell on his leg; he recovered from the injury, and was well for twenty years, when he had a second blow on the same part, which was followed by ulceration of the integuments and discharge of small pieces of bone. The ulceration extended in both width and depth till the limb was removed. The principle arteries of the limb were ossified.

I. 42.—Section of a leg, exhibiting a growth of soft, vascular, warty fungus from its front part. The base of the growth is consolidated with the periosteum, which for some distance above and below has become soft, spongy, and has its connection with the bone loosened. The bone itself is healthy, except that there has been an irregular ulceration of its external surface.

I. 42A.—Portions of the tibia and fibula from the leg last described, more plainly showing the ulceration of their anterior surfaces.

From a woman thirty-five years old. She received a blow on the shin when ten years old, which was followed by abscess and discharge of small pieces of bone. The parts healed and remained well for many years; but again abscess formed, and again healed; and after this had been several times repeated, the growth here shown sprouted out, and the patient's health failing the limb was removed.

I. 59.—A tibia, in which there is a circumscribed oval ulcer, which has destroyed the anterior half of its walls, laying open the medullary cavity. There is scarcely any appearance of separation; the edges of the ulcer are sharp and uneven, and the adjacent bone is light, but not otherwise unhealthy.

I. 74.—Sections of a tibia and fibula. A portion of the tibia near its lower end has been destroyed by ulceration due to an epithelial cancer.

I. 75.—Section of a tibia. The walls are generally thickened, and the cancellous tissue is consolidated by osseous deposit, except in one part near the upper end of the bone. The periosteum is everywhere altered in its texture, but especially so at the lower part of the bone, where a thick fleshy growth has taken place from it.

The disease had existed twenty-five years, having commenced in a severe laceration of the integuments, which never perfectly healed.

Sub-series A. 77.—Portions of a tibia and fibula. A large portion of the shaft of each bone has been destroyed by ulceration, in consequence, probably, of some malignant disease; as in A. 74, the margins of the ulcer are abrupt, sharp, and excavated.

COLLOID CANCER.

Colloid cancer of bone is rare. There is no specimen in the Museum.

HYDATIDS.

Hydatids in bone are very rare. We have only one specimen in the Museum.

I. 215.—Half a pelvis, exhibiting the effects of the growth of hydatids within the bones. The walls of the ilium are separated, and are in many places absorbed, so that there are large apertures in them, which open into a cavity extending through its whole interior. The same cavity communicates with that of the pelvis by a large opening in the acetabulum, and, by other openings, with a cavity in the interior of the sacrum, and with the spinal canal. There are several apertures in the posterior part of the sacrum. All these cavities are filled with hydatids, which had also protruded through the apertures in the walls of the bones, and were contained in cysts formed by the thickened periosteum and other tissues.

I. 216.—Part of the acephalocyst hydatids which were contained in the above bones.

CHAPTER II.

INJURIES OF THE BONES.

FRACTURES.

GENERAL PATHOLOGY.

A FRACTURE is defined as a solution of continuity of a bone.

VARIETIES OF FRACTURE.

Fractures may be divided into simple, compound, incomplete, comminuted, and complicated.

Simple, when the bone is broken into two pieces (III. 113).

Compound or open, when an external wound communicates with the broken fragments (III. 99, III. 145.)

Incomplete or greenstick (only occurring in children), when the bone is partly broken and partly bent. (No specimen.)

Comminuted, when the bone is broken into more than two fragments. (III. 129.)

Complicated, when the fracture is combined with some other injury. (III. 118, III. 145.)

CAUSES OF FRACTURE.

The determining causes of fracture are muscular action or external violence. The violence may be direct or indirect. As the causes of fracture belong more to the study of clinical surgery than to that of pathology, we may dismiss them with the above brief reference.

STATE OF THE PARTS.

The state of the parts, *i. e.* the condition of the ends of the fragments and of the parts around, will be described and illustrated under "Special Fractures."

PROCESS OF REPAIR IN FRACTURE.

The process of repair in simple fracture will first be described, and afterwards the modifications observed in compound fracture.

REPAIR IN SIMPLE FRACTURE.

The process in the human subject differs somewhat from that in the lower mammalia. In the latter it has been very completely studied by producing artificial fractures and killing the animal at varying periods afterwards; it is well illustrated by the beautiful but incomplete series of specimens prepared by Mr. Stanley. The student should first master the process as it occurs in the lower animals, and then compare with it that which occurs in man.

In animals (dogs and cats).

General outline of the process.—Immediately after the fracture blood is effused about the ends of the fragments, but in a few days is in great part absorbed and replaced by reparative material called callus. The blood is believed by some, however, to become organised, and to assist in the formation of the callus.

The callus, which is produced in part by the bone, and in part by the periosteum and other adjacent soft tissues, occurs in three situations—around the ends of the fragments for some distance above and below the line of fracture (ensheathing callus), between the ends of the fragments (intermediate callus), and within the medullary canal (internal callus). It is at first composed almost entirely of small round cells (granulation tissue); these are converted into fibrous tissue, then into cartilage, and finally into bone, which firmly unites the fragments. The ensheathing and internal callus are after a time almost completely absorbed, so that but little, if any, trace of the fracture remains.

Appearances at different periods after fracture.

First day.—(Specimen wanted). The soft parts immediately around the fragments are more or less bruised and lacerated. Blood in varying quantities is effused in the lacerated tissues about the ends of the fragments, and in the medullary canal. The periosteum is generally torn across at the line of fracture, but is not, as a rule, much lacerated or stripped off from the fractured ends.

Third or fourth day.—(Specimen wanted). The extravasated blood is partly absorbed, the periosteum is softened, infiltrated with inflammatory material, and blended with the adjacent soft tissues, forming with them a spindle-shaped swelling around the seat of fracture.

Ninth or tenth day.—(III. 69). Section of the tibia of a dog, ten days after fracture of the shaft. The line of fracture is distinctly visible. The extravasated blood has disappeared, and a ring-shaped mass of cartilaginous substance (temporary or ensheathing callus) is seen around and for some distance above and below the fracture, between the bone and what appears to be the periosteum. A few minute specks of earthy matter appear in the centre of the callus. A similar mass of cartila-

ginous substance (internal callus) occupies the medullary canal at the place of fracture.

III. 70.—The other half of III. 69. The periosteum (P) is turned downwards, and completely separated from the cartilaginous substance deposited upon the bone around, above and below the line of fracture.

The origin of callus, as above stated, has been variously attributed to the periosteum, to the medullary membrane, to the other soft parts about the seat of fracture, to the bone itself, and even to the extravasated blood. It is probable, however, that all contribute to its production, but more especially the bone and periosteum.

The following specimens were prepared by Mr. Stanley, who supposed that callus was produced by the periosteum only. In III 86, in which portions of both bone and periosteum were removed, new bone was not produced; but it was formed in considerable quantities in III 87, where a portion of bone alone was removed.

III. 86.—The radius and ulna of a dog. A portion of the middle of the shaft of the radius, in its entire thickness, including its periosteum, was removed ten weeks before the dog was killed. In the upper part of the bottle is the piece of bone which was thus removed. The shaft of the ulna opposite to and corresponding with the vacancy in the radius, is considerably enlarged by the deposit of osseous substance beneath the periosteum, but the vacant space itself was found filled by soft cellular tissue, no bone having been formed there.

III. 87.—Radius and ulna of a dog, on which an experiment was performed similar to that described in III. 86, with this exception, that the bone alone was removed, the periosteum being divided and separated by a scalpel from the bone, to admit of the removal of the latter from within it. The vacant space in the radius is here completely filled by newly formed osseous substance.

III. 88.—A similar specimen.

Fourteenth to eighteenth day. III. 96.—Section of the tibia of a dog which was fractured a fortnight before death. New osseous substance is thinly deposited in a ring beneath what appears to be the periosteum, but at the line of fracture the osseous union is incomplete.

III. 71.—A similar specimen, exhibiting the process of union on the eighteenth day after a like fracture. Ossification is slightly more advanced; otherwise the appearances agree with those observed on the fourteenth day.

A considerable time after fracture. III. 115.—A femur and tibia of a cat. A fracture of the femur near the middle of the shaft is united by complete ossification of the callus formed around and between the ends of the overlapping fragments.

A very long time after fracture. (Specimen wanted.)—Most, if not all, of the ensheathing callus has disappeared, the cortical layers of

the shaft are firmly united by bone, and the internal callus has been in great part absorbed, so that the medullary canal is again patent.

Process of repair in man.

Repair of fracture has been less perfectly investigated in man than in the lower animals. Although the process on the whole appears to be very similar, there are some well-marked differences which must here be noticed.

In the case of man, as in that of lower animals, extravasation of blood occurs about the ends of the fragments, and is followed after a short period by slight inflammation, which in a few days subsides. It is at this stage that the first difference is observed. In man, according to Sir James Paget, after the subsidence of the inflammation, the parts around the fragments remain for a period at rest, no reparative material being produced for a week or fortnight after the injury; whereas in animals (dogs), as we have seen, the reparative material has not only been formed by the end of that period, but has been converted into cartilage, and in great part into bone. Another difference observed in man is the absence of ensheathing callus. In animals, as before remarked, callus is produced around and between the ends of the fragments and within the medullary canal: in man, between the ends of the fragments only, and this is still the case even when the fragments overlap, as also when they are slightly separated or placed at angles to each other. In some instances, where the fragments are very accurately in apposition, immediate union (comparable with the so-called immediate union of soft parts) is thought to occur without the production of any callus.

Although we have described union in man as taking place without the intervention of ensheathing callus, this is not always the case, as in fractures not kept at rest, the irritation consequent on the constant movement of the fragments gives rise to abundant production of ensheathing callus, as in animals. Thus, it is always produced in the ribs, the constant movement of which is unavoidable, and generally in the clavicle, where it is difficult to keep the fragments at rest, and occasionally in other bones, but only when the fracture has not been properly secured in splints. It is also met with in all fractures in young subjects, even though splints have been carefully applied and the fragments kept absolutely immovable.

The manner in which the callus is converted into bone constitutes another difference between the process of repair in man and animals. In animals the callus passes through a cartilaginous

stage before becoming ossified; whereas in man it often undergoes ossification without passing through any intermediate condition, or at most after having been transformed into fibrous tissue or fibro-cartilage, but never into true cartilage.

THE NORMAL PROCESS OF REPAIR IN ADULTS, *i. e.* WITHOUT
ENSHATHING CALLUS.

I.—*By immediate union—rare.*

III. 45.—An intra-capsular fracture of the neck of the femur. Immediate union appears to have occurred. The fragments were probably impacted. See also sub-series C. 57 and 78.

II.—*By intermediate callus—common.*

When the fragments are in accurate apposition. III. 104.—Section of a humerus in which a fracture of the shaft at the attachment of the deltoid muscle has been exactly united, so that both the walls and the cancellous tissue are uninterruptedly continuous; and except by a slight deviation of its axis, the situation of the fracture could hardly be discerned.

When the fragments overlap. III. 113.—Sections of the tibia of a middle-aged woman, which was fractured through the junction of its middle and lower thirds sixteen weeks before death. The ends of the two portions overlap each other nearly an inch, and a firm union of them is effected by new bone, formed between those surfaces, which in their overlapping were apposed, and partly in contact with each other. No new bone or callus is formed at any other part. The periosteum and the tissues adjacent to the bones appeared healthy, except in having small effusions of blood in them.

When the fragments are separated III. 98.—Section of a femur, showing that even when there is much displacement no ensheathing callus is formed. The section was made after softening the bone in dilute hydrochloric acid. The fracture is firmly united, with the upper portion of the bone projecting in front and on the inner side of the lower. The uniting medium consists of bone placed between the adjacent surfaces of the displaced portions of the femur; and in this new bone there are formed cancellous tissue of healthy aspect and an outer thick wall of compact tissue. This wall of the uniting medium of new bone is connected with the surfaces of the two portions of the femur, and with the layers of compact new bone by which their medullary tubes, exposed by the fracture and not placed in apposition, are covered in. The other section is preserved in Sub-series C. 63. See also Sub-series C. 4, 5, 26, 70, 93, and I. 90.

When the fragments are placed at an angle to each other. III. 94.—Sections of a radius. At its carpal end there has been a transverse fracture immediately above the line of the epiphysis, and the posterior or dorsal margin of the upper fragment has been driven into the cancellous tissue of the lower one. The fracture is united and a buttress

of new bone has formed on the dorsal and radial sides of the displaced portions. See also Sub-series C. 116 and 127.

**THE EXCEPTIONAL METHOD OF REPAIR IN ADULTS, *i. e.* WITH
ENSHEATHING CALLUS.**

In the ribs. III. 106.—Parts of two ribs, which were fractured a fortnight before death. The extremities of the fractured portions are in close contact, and are surrounded by a broad ring of callus, partially ossified. A section of one of the ribs shows the periosteum continued over the exterior of the callus.

In the clavicle. III. 133.—The outer portion of a clavicle divided longitudinally, from a boy aged nine years. It was fractured about three weeks before death. Note the abundant ensheathing callus.

In bones (other than ribs and clavicle) when the fragments have not been kept at rest. III. 128.—A fractured femur, with abundant production of ensheathing callus around the fractured ends, probably the result of the fragments not having been properly kept at rest by splints.

III. 65.—Section of a humerus, in which a fracture of the middle of the shaft occurred five weeks before death. The ends of the bone are not united, but they are held firmly together by a ring of rough osseous substance deposited on the whole circumference of their outer surfaces, and extending some way above and below the fracture.

III. 66.—The other half of the humerus, No. 65, macerated.

**THE NORMAL PROCESS OF REPAIR IN YOUNG SUBJECTS, *i. e.* WITH
ENSHEATING CALLUS.**

III. 124.—Sections of a child's femur, which was fractured thirty days before death. The sharp extremities of the fragments are projecting, but except at these ends they are in close apposition. Both fragments, to a distance of between one and two inches from the line of fracture, are surrounded in a layer of new bone (ensheathing callus). The fragments thus ensheathed and held together almost immovably by the new bone are not directly united; the line of fracture is still evident between them, but some new bone appears in the medullary cavity of each. The child was two years and ten months old. The fracture was treated in the usual manner. Splints were kept on for three weeks, and being removed, the limb was maintained at rest.

To sum up: repair in man is generally accomplished without the production of ensheathing callus, either by immediate union when the ends are very accurately apposed, or by intermediate callus when the apposition is less perfect, when the ends overlap, or are separated by a slight interval. But the union takes place by ensheathing callus when the fractured ends are not kept constantly in one position, *e. g.* in the ribs, which are subject to constant movement, in other bones when immobility is not attained, and in the bones of young subjects.

CHANGES SUBSEQUENT TO UNION OF THE FRAGMENTS.

After the fragments have been firmly united by some of the methods above described, further changes occur providing for the symmetry of the bone (Paget). Sharp and projecting angles in badly united fractures and rough ends of overlapping fragments are absorbed and rounded off, and the exposed ends of the medullary canal closed by a layer of new bone. Ensheathing callus, when this has been produced, is in great part or wholly absorbed; the bony callus between the fractured ends, at first spongy, gradually becomes compact, whilst that in the medulla becomes more and more cancellous till at last the continuity of the canal is restored.

When the fragments overlap and the ends of the medullary canal have become closed, the continuity of the canal is restored by absorption of the intervening walls of the contiguous and overlapping fragments.

Sub-series C. 19.—Section of a femur which has been broken near the middle of its shaft. The fragments have overlapped considerably. The bone forming the medium of their union has a cancellous texture with compact walls. The medullary cavity is closed at both the fractured ends of the bone. See also Sub-series C. 20, 30, 32, 61, 63, and 68.

DEVIATIONS FROM THE ORDINARY PROCESS OF REPAIR.**FIBROUS UNION.**

Some fractures are seldom or never united by bone but remain merely bound together by ligamentous or fibrous tissue. These include fractures extending into joints, and are as follows:

Intra-capsular fracture of the humerus and femur, fractures of the patella, the olecranon, the coronoid process, condyles of the humerus, and tip of the acromial and coracoid processes.

UNUNITED FRACTURE.

An ununited fracture is one in which the fragments remain totally separate, or bound together only by fibrous tissue. As this definition stands, it includes the fractures enumerated under the previous heading. But as fibrous union, in their case, appears to be the normal method of repair, they have been placed under the head of fibrous union rather than that of ununited fractures. When, however, union by fibrous tissue occurs in those fractures in which bony union is the normal method of repair, the fracture is said to be ununited.

The condition of the fragments in ununited fracture varies. In a few instances the bones are found completely separated, the ends

rounded off, and the medullary canal closed. In other instances they are found connected by fibro-cartilaginous material, a kind of ensheathing callus; instances in which it is probable that union, although retarded, might have taken place at a later period, and should be considered rather as examples of *delayed union* than of ununited fracture. In other instances, again, the fragments are bound closely together by tough fibrous tissue, which allows of but little movement, or by thin, elongated, pliable ligamentous-like bands, permitting of considerable movement.

Occasionally, after union has taken place in the ordinary way, the osseous material uniting the fractured ends is absorbed; in such a case the fracture is sometimes called *disunited*, to distinguish it from the ordinary form of ununited fracture in which bony union has never occurred.

Sub-series C. 86.—Portion of a Femur in which there has been a fracture through the shaft a little below the neck. The fracture was united by ligamentous substance which separated in maceration. It occurred nine months before death. See also III. 147.

Sub-series C. 121.—Part of a right femur just above its middle, representing the extremities of an ununited fracture. There are deposits of new bone scattered over either portion, the medulla being closed by a compact layer of dense bone-tissue. The apertures indicate the spots selected for the introduction of ivory pegs. The depressions are lined with new bone, from which spicula irregularly project.

FALSE JOINT (PSEUDARTHROSIS).

This is merely a variety of an ununited fracture, in which the ends have been rounded off and covered by a layer of fibrous or fibro-cartilaginous material, and enclosed in a strong fibrous capsule formed by the condensation of the surrounding soft tissues. A fluid resembling synovia has been occasionally observed within the capsule. Two main varieties of false joint exist, one resembling the hinge, the other the ball-and-socket joint. The former is more common in fractures of the articular ends, the latter in those of the shafts of the long bones. The existence of a false joint implies that there has been a considerable amount of movement of one fragment upon the other.

III. 2.—Portion of a humerus, in the middle of the shaft of which fracture occurred four years before death. The ends of the bone did not unite, but are enlarged, have become accurately adapted to each other, and have acquired a hard polished surface on those portions between which there was friction during the movements of the arm.

III. 3.—Portion of a humerus, in which fracture of the shaft occurred many years before death. The ends of the bone did not unite: they

are somewhat enlarged, and are covered by a substance like fibro-cartilage, and connected by a distinct membranous capsule, which is smooth upon its internal surface, and serves as a kind of capsular ligament to the false joint which is formed between the ununited portions of the bone. See also III. 58 and Sub-series C. 77.

REPAIR IN COMPOUND FRACTURE.

When the wound leading to the seat of fracture is small, and has been closed early, the process of repair is much the same as in simple fracture. When, however, the wound is large, suppuration ensues, and union of the fragments is effected by granulations springing from the ends of the bones and from the periosteum, the process being analogous to the so-called union by the second intention of soft parts. If there is much comminution of the bone and bruising of the soft parts the loose fragments and injured tissues are cast off in the process of suppuration. The granulations uniting the fractured surfaces undergo direct ossification, or first pass through a fibrous stage. When large portions of bone are denuded of periosteum, the portions thus bared, die and are cast off from the living, as in the separation of a sequestrum. Sometimes, however, the dead bone becomes deeply embedded by ossification of the parts around, and remains as a source of irritation for years.

III. 34.—A knee-joint. The upper fragment was forced downwards by the side of the patella, and a few days after the fracture, protruded through the integuments and could not be replaced. In this situation it has become firmly fixed by bone to the condyles. An inch and a half of the protruding portion is in process of sequestration.

III. 79.—Section of a tibia, from a case of compound fracture, in which amputation was performed eleven weeks after the occurrence of the injury. The two portions of bone are held firmly together by osseous substance deposited around the torn edges of the periosteum and in the contiguous cellular tissue. The union of the fractured surface of the walls of the bone and of its medullary tissue is not yet complete, the uniting medium here consisting of granulations growing from the exposed ends of the bones.

III. 90.—Section of a tibia, in which a compound fracture occurred six months before death. The fractured surfaces, displaced and overlapping, are consolidated by bony matter. The extremity of one of the portions of fractured bone, separated either by the fracture or by exfoliation, lies loose in a cavity between the fractured surfaces. The portion of bone at the bottom of the bottle was found loose in the same cavity. The other half of the bone is preserved dry, in Sub-series C. 93.

See also III. 90, and 147 and I. 87 and 88.

SPECIAL FRACTURES.

FRACTURES OF THE BONES OF THE FACE.

The bones of the face most liable to fracture are the nasal, the lower maxillary, and the malar bones.

FRACTURE OF THE NASAL BONES.

Fracture of the nasal bones is always produced by direct violence. The fracture is transverse in direction, and generally accompanied by considerable displacement. Interest attaches to this fracture from the fact that it is liable to extend to the perpendicular plate of the ethmoid, and through this to the base of the skull, frequently giving rise to inflammation of the brain.

III. 75.—Nasal bones, exhibiting the union of a transverse fracture just above their lower borders.

Sub-series C. 72.—Portion of skull, in which there has been a fracture extending across the nasal bones. The fracture has united firmly, but with lateral displacement and overlapping of the lower portions of the bones.

Sub-series C. 83.—Section of the skull, in which there has been a transverse and comminuted fracture of the nasal bones. The fracture has united with considerable lateral displacement of the lower portion of the bones.

FRACTURE OF THE MALAR BONE.

Sub-series C. 100.—Part of a skull, in which a depression of the zygoma into the temporal fossa appears to indicate that there has been a fracture near the junction of its malar and temporal portions.

FRACTURES OF THE RIBS AND COSTAL CARTILAGES.

Fractures of the ribs may be the result of direct or indirect violence. In the former case the fracture occurs at the seat of the violence, and the fragments are driven inwards towards the chest, frequently injuring the pleura and lung. In the latter case, the rib generally gives way at its weakest part, that is, at the greatest convexity of its curve. Union normally takes place by means of a ring of ensheathing callus, as in animals.

III. 106.—Parts of two ribs which were fractured a fortnight before death. The extremities of the fractured portions are in close contact, and are surrounded by a broad ring of callus, partially ossified. A section of one of the ribs shows the periosteum continued over the exterior of the callus.

Sub-series C. 23.—Two ribs which have been fractured. In one rib

the fracture occurred near its middle, and in the other near its angle. There has been very little displacement of the ends of the bones, and the fractures are firmly and smoothly united.

III. 81.—Section of a fractured rib, which has reunited with displacement and overlapping of its ends. The firm union of the two portions of the rib has been effected by the abundant deposit of osseous substance in the texture of the periosteum and contiguous cellular tissue around, and for some way above and below the fracture. A spiculum of bone projects from one side of the rib; this was probably a fragment separated by the fracture and reunited to the outer surface of the rib.

Sub-series C. 74.—A rib which has been fractured in three distinct situations—at the angle and in the middle of the shaft. The fractured ends are firmly united in nearly exact apposition.

Fracture of the Costal Cartilages.

The costal cartilages, unlike the ribs, are rarely fractured, owing to their greater elasticity. Union is generally effected by ensheathing callus, which subsequently ossifies, so that the two cartilaginous fragments appear united by a ring of bone. Occasionally, however, the callus remains cartilaginous.

Fracture may sometimes occur through the line of union of the cartilage and the ribs; repair in this case takes place by a ring of bony callus, situated partly under the periosteum and partly under the perichondrium.

III. 73.—Portions of costal cartilages. There has been a fracture of the cartilage of one of the false ribs. The portions overlap and are firmly united by bone.

III. 48.—Section of the cartilage of a rib, which has been fractured and is firmly united. The uniting medium consists of a substance like cartilage with small deposits of bone in it.

III. 4.—Section of the cartilage of a rib, which appears to have been fractured and reunited by new cartilaginous substance placed in the angles between the ends of its overlapping portions.

Separation of a rib from its cartilage.

III. 82.—Section of a rib with its cartilage. The rib had been separated from the cartilage, but has reunited to it. The union is effected by an abundant deposit of osseous substance, apparently in the texture of the periosteum and perichondrium, and in the contiguous cellular tissue around and for some way above and below the line of separation.

FRACTURE OF THE STERNUM.

The sternum, notwithstanding its exposed situation, is rarely fractured, as its position between the elastic cartilages enables it to resist any but severe and direct violence. The fracture is always

transverse and usually single. One or more ribs are generally broken at the same time.

Sub-series C. 46.—A sternum, fractured transversely through its second portion near its union with the first.

Sub-series C. 47.—A sternum, fractured transversely through its second portion near its junction with the third.

FRACTURES OF THE UPPER EXTREMITY.

FRACTURE OF THE CLAVICLE.

The clavicle may be fractured through the shaft or through either end.

The former fracture is common, the latter fractures are rare.

Fracture of the Shaft.

Fracture of the shaft usually occurs near the middle of the bone. The inner fragment, although it appears to be displaced upwards, really retains its normal position in consequence of the antagonistic action of the sterno-mastoid above and the pectoralis major below; the costo-clavicular ligament will also tend to prevent the inner fragment from being displaced upward. The outer fragment is displaced downwards, forwards, and inwards, by the weight of the arm and the contraction of the pectoral muscles.

Union is generally accomplished by ensheathing callus, as it is impossible to keep the fragments in position unless the patient submits to lie flat on the back for a few weeks.

III. 92.—Section of a clavicle, exhibiting a fracture which occurred while the patient was holding a weight above his head.

III. 134.—A clavicle of a man seven weeks after fracture.

Sub-series C. 32.—A clavicle, which has been broken near the middle of its shaft.

The fracture is united with the scapular end of the bone beneath its sternal end.

Sub-series C. 68.—A clavicle, which has been fractured obliquely near the middle of its shaft. The fracture has united with scarcely any irregularity of the surface of the bone.

Sub-series C. 82.—Section of a clavicle, in which an oblique fracture through the middle of the shaft has been exactly united.

Fracture of the Acromial End.

Fractures of the acromial end are generally productive of but little displacement, as the strong coraco-clavicular ligaments retain the fragments nearly in position.

III. 35.—The scapular end of a clavicle, with a small portion of bone united to it by a distinct joint. It is, however, uncertain whether this portion of bone was separated by fracture.

III. 133.—The outer portion of a clavicle, divided longitudinally, from a boy aged nine years. It was fractured about three weeks before death.

FRACTURES OF THE SCAPULA.

Fractures of the scapula may be divided into the following classes:—Fractures of the body, coracoid process, acromion, glenoid cavity, neck, and inferior angle.

As there are no specimens in the Museum of the two latter, they will receive no further mention.

Fractures of the Body.

Fractures of the body are due to direct violence. The fracture usually takes a transverse direction across the infra-spinous fossa, but the bone may be split longitudinally, or it may be starred. The union takes place by bone.

Sub-series C. 33.—A scapula, which has been broken transversely through its infra-spinous region. It has also received other injuries, which will be referred to further on. The fracture has united by bone.

Fracture of the Acromial Process.

Fracture of the acromion usually occurs through the apex; it may, however, occur through the middle or through the base. When the fracture is through the apex, the union is fibrous; when through the base, bony; when through the middle, either fibrous or bony.

III. 36.—Portion of a scapula, exhibiting a fracture through the apex of the acromion, which has united by fibrous tissue.

See also Sub-series C. 33.

Sub-series 142.—“ In this specimen the acromion, at one inch from its extremity, is completely divided transversely, but in the recent state the fragment was maintained in its proper position by means of ligamentous tissue, so that no displacement had occurred. At a distance of three quarters of an inch further on towards the spine the acromion is again almost completely divided in a transverse direction, the two portions being held together by two narrow bridges of bone.” The glenoid cavity exhibits the appearances commonly observed in chronic rheumatic arthritis.

Specimens similar to the above are believed by Dr. Robert Adams and Professor Smith to depend, not upon fracture but upon a separation of the acromial epiphysis consequent upon chronic rheumatic arthritis. From the fact, however, as seen in the above specimen, that the separation may take place at some other part of the acromion than in the position of its epiphysial line, Mr. Marsh doubts whether there is any physiological connection between this separation of the acromion and its former condition as an epiphysis.

Fracture through the Coracoid Process.

Fractures of the coracoid process are rare. They are always due to direct violence, such as a blow on the shoulder. There is usually but little displacement, the fractured portion being held in position by the strong ligaments connecting it to the clavicle and the acromion. The fracture most commonly extends through the base, when it is often complicated by fracture through the body of the scapula. When the fracture is through the apex, union is fibrous.

Sub-series C. 89.—A scapula, with part of the humerus, from a young person. The fracture extends through the base of the coracoid process, and through the body of the scapula.

Sub-series C. 120.—A scapula. The extremity of the coracoid process is seen separated from the rest of the bone, probably in consequence of fracture. There has been no attempt at bony union; the fragments are kept in position by dense fibrous tissue. See also Sub-series C. 142.

Fracture through the Glenoid Cavity.

This is an extremely rare form of fracture; it apparently occurred in the following specimen:

Sub-series C. 102.—A scapula, in which there seems to have been fracture of the lower margin of the glenoid cavity.

FRACTURES OF THE HUMERUS.

These may be divided into fractures of the upper end, shaft, and lower end.

I. FRACTURES OF THE UPPER END.

These may be classed as—

1. Intra-capsular, impacted and non-impacted.
2. Extra-capsular, impacted and non-impacted.
3. Fracture of the greater tuberosity.
4. Separation of the epiphysis and fracture through the line of the epiphysis.
5. Fracture of the surgical neck.

Intra-Capsular fracture.

Intra-capsular fracture extends through the anatomical neck, and, as its name implies, is within the capsular ligament. It may be impacted or non-impacted. In the impacted variety the upper fragment or head is always driven into the lower, that is, between the tuberosities.

Union, when it occurs in the non-impacted variety, is ligamentous. In the impacted it is bony.

Sub-series C. 103.—A scapula and humerus, in which there has been a dislocation of the head, with an intra-capsular fracture of the neck of the humerus. The head of the bone was found resting against the anterior border and concave surface of the scapula, close to the glenoid cavity, and below the coracoid process.

Extra-Capsular fracture.

In the extra-capsular fracture, the humerus is broken at the junction of the shaft and tuberosities immediately external to the capsular ligament. Like the intra-capsular, it may be impacted or non-impacted; but in the impacted variety it is the lower end which is driven into the upper, not the upper into the lower, as in the intra-capsular.

III. 74.—A shoulder-joint, exhibiting an ununited fracture of the neck of the humerus. The fracture extends transversely through the humerus, immediately below its head and below the tuberosities, and it communicates with the cavity of the shoulder-joint. From a man aged seventy-five. The injury occurred ten years before death.

Fracture of the Greater Tuberosity.

There is no specimen of this in the Museum.

Separation of the Epiphysis and Fracture through the line of the Epiphysis.

This can necessarily only occur in young subjects, *i. e.* before the epiphysis has become united and consolidated with the shaft. A good specimen follows.

Sub-series C. 89.—A scapula and humerus from a young person, exhibiting the separation of the head from the shaft of the humerus in the line of the epiphytic union.

Fracture of the Surgical Neck.

The line of fracture in this injury extends through the upper part of the shaft below the tuberosities, but above the insertion of the three muscles into the bicipital ridges of the humerus. The upper fragment is displaced outwards by the action of the three muscles inserted into the greater tuberosity, whilst the lower fragment is drawn inwards by the three muscles inserted into the bicipital ridges, and upwards by the deltoid.

Sub-series C. 104.—Bones of a shoulder-joint, exhibiting a fracture of the surgical neck of the humerus, just below the tuberosities.

Sub-series C. 26.—A similar fracture.

II. FRACTURE OF THE SHAFT.

Fracture of the shaft may be caused either by direct or indirect violence; it has been known to occur from violent muscular action. The usual situation of the fracture is a little below the insertion of the deltoid. The line of fracture may be transverse or oblique; in the latter case it generally runs downwards and outwards. In transverse fracture but little displacement occurs, but in the oblique the lower fragment is drawn upwards and to the inner side of the upper by the action of the biceps and triceps muscles, while the upper fragment is abducted and rotated outwards by the action of the deltoid and external rotator muscles.

III. 104.—Section of a humerus, exhibiting a transverse fracture of its shaft just below the insertion of the deltoid. There is no displacement.

Sub-series C. 122.—Part of a humerus, fractured transversely. The fractured ends overlies each other.

III. 122.—A humerus, fractured transversely below the middle of the shaft. No union has taken place between the fractured portions, the ends of which overlap.

Sub-series C. 25.—Section of a humerus, which has been fractured obliquely just above the middle of its shaft and just below the insertion of the deltoid.

Sub-series C. 24.—A humerus, which has been fractured in several directions, but chiefly obliquely downwards, just above the condyles. The fractures are firmly united, but an aperture remains in the line of one of them.

Sub-series C. 61.—Section of a humerus, which has been fractured obliquely just below the middle of its shaft.

Sub-series C. 79.—See the humerus in this specimen. The fracture is situated just below the insertion of the deltoid.

III. FRACTURES OF THE LOWER END.

Fractures through the lower end of the humerus generally extend transversely across the bone immediately above the condyles and vertically between the condyles into the elbow-joint. Either condyle may be broken off without any other part of the lower end being affected. Separation of the lower epiphyses is also met with in young subjects.

Sub-series C. 36.—The bones of an elbow-joint. The humerus has been fractured obliquely between the condyles and transversely a little above them.

III. 46.—Portion of a humerus, in which distinct fractures extend vertically through both condyles into the elbow-joint. The fractured surfaces are united by fibrous tissue.

Sub-series C. 38.—The bones of an elbow-joint. A fracture extends in two directions through the internal condyle of the humerus into the elbow-joint. The fragments are not united by bone.

III. 13.—An elbow-joint, in which the head of the radius was dislocated backwards. No reduction of the dislocated bone having been effected it has become extensively united to the side of the ulna. There appears also to have been a fracture of the internal condyle. All the bones are atrophied.

FRACTURES OF THE BONES OF THE FOREARM.

These may be divided into fractures of the radius, fractures of the ulna, and fractures of both radius and ulna.

FRACTURES OF THE RADIUS.

Fracture of the radius may occur through the neck, lower end, or any part of the shaft. Fracture of the neck is very rare; we have no specimen of it in the Museum. Fractures of the shaft and lower end are common.

Fracture of the Shaft.

Fracture of the shaft may be produced by direct violence, but more frequently by a fall upon the hand. The fracture may occur in any situation, but is most common near the middle of the shaft. The upper fragment is drawn forwards by the biceps, and inwards by the pronator teres, and is held in a position by the opposing action of these muscles midway between supination and pronation. The lower fragment is drawn inwards and pronated by the pronator quadratus, the inward inflection being aided by the supinator longus dragging on the styloid process.

Sub-series C. 30.—A radius, which has been fractured near the middle of its shaft. The fracture is united with a little overlapping of the ends of the bone.

Sub-series C. 62.—A radius and ulna. The radius has been fractured at the middle of its shaft. The ends of the bone projecting forwards and inwards close to the ulna have been smoothly united in this position.

Fracture of the Neck.

Fracture of the neck is nearly always due to direct violence. The upper fragment is displaced outwards by the supinator brevis; the lower fragment is drawn upwards and forwards by the biceps and inwards by the pronator teres.

There is no specimen in the Museum.

Fracture of the Lower End (Colles' Fracture).

This is nearly always the result of indirect violence, generally of a fall upon the palm of the hand. The line of fracture is usually transverse, and about half an inch to an inch above the articular surface of the wrist-joint.

Although this fracture is exceedingly common, opportunities of examining the parts after death seldom occur. There is consequently much difference of opinion as to the condition of the fragments and the cause of their displacement. According to Dr. R. W. Smith, the lower fragment is drawn upwards and backwards by the combined action of the supinator longus, the extensors of the thumb and the radial extensors of the carpus; by others, however, the displacement is believed to be the result of impaction, which, they maintain, nearly always occurs. The latter opinion has the support of Mr. Callender, who, in a paper in 'St. Bartholomew's Hospital Reports' for 1865, explains the displacement as follows: "The radius is first broken, and then, by the momentary continuance of the force in the direction of the falling body forwards and outwards, the shaft is driven into the carpal end, burying itself chiefly from the dorsal surface towards the palm and towards the outer or the inner side. In a great number of cases this impaction so fixes the fragments that they cannot be unlocked, and the deformity is permanent." The following specimens will be seen to bear out this view.

The upper fragment is generally approximated to the ulna, and in a state of pronation.

The lower fragment is sometimes comminuted.

III. 78.—Section of the radius of a young man, which has been fractured three quarters of an inch above its carpal articular surface. The posterior, or dorsal margin of the upper fragment is driven into the cancellous tissue of the lower one; their palmar margins are in contact, but a projecting angle is here formed, in front of the wrist, at the line of fracture.

III. 94.—Sections of a radius. At its carpal end there has been a transverse fracture immediately above the line of the epiphysis, and the posterior or dorsal margin of the upper fragment has been driven into the cancellous tissue of the lower one. The palmar margin of the upper fragment projects forwards, or in the direction of the palm, and the dorsal surface of the lower fragment projects far backwards, similarly to that in III. 78, but differently from that in III. 89.

III. 89.—Portions of a radius and ulna. The radius has been fractured a little more than an inch above its carpal end. The union is firm, but there is a prominent angle on the dorsal aspect of the radius in the line of fracture, and an elevation of new bone on the

corresponding part of the palmar surface, where it is probable that the palmar margin of the upper fragment was driven into the cancellous tissue of the lower one. The triangular fibro-cartilage was almost completely separated from the radius.

Sub-series C. 35.—Portion of a radius, which has been fractured about an inch above its lower end. The fracture has united with a considerable overlapping of the ends of the bone, the palmar margin of the upper portion projecting with a sharp edge towards the palm, while its posterior or dorsal margin is driven into the cancellous tissue of the lower portion. The lower portion with the carpal articular surface of the radius is consequently deflected strongly backwards, or towards the dorsal region of the forearm.

III. 125.—The carpal extremity of a radius and ulna, showing a comminuted fracture of the former bone, extending into the wrist-joint, and a small amount of displacement resulting from the injury, which during life was indicated solely by pain and inability to move the part affected.

The fracture was consequent upon a fall on the hand, the man receiving at the same time such internal injuries that he died a few hours after his admission.

Sub-series C. 31.—A radius and ulna. The radius has been broken about three quarters of an inch above its lower end.

The fracture is united, with the lower portion of bone displaced towards the radial and dorsal aspect of the upper portion. In consequence of the shortening of the radius, induced by this displacement, a new articular surface has been formed on the lower end of the ulna by the growth of a half-ring of bone upwards from the margin of the surface by which it before articulated with the radius. The carpal articular surface of the ulna thus projects far beyond that of the radius.

FRACTURES OF THE ULNA.

Fractures of the ulna may be divided into fractures of the olecranon process, fractures of the coronoid process, and fractures of the shaft.

Fracture of the Olecranon Process.

Fracture of the olecranon process may be caused by a blow or fall upon the elbow, or by a violent action of the triceps muscle. The fracture may extend through the base, middle, or apex of the process, in either a transverse or an oblique direction. The detached fragment is generally widely separated from the rest of the bone by the contraction of the triceps, but when, as occasionally happens, the periosteum and the tendinous expansion of the triceps covering the olecranon are not torn, or when the fracture is very oblique, little or no separation occurs. Union is generally fibrous, but in the more exceptional cases in which little or no separation of the

fragments occurs, union usually takes place by bone. The elbow joint is generally involved.

III. 6.—An elbow-joint, exhibiting a transverse fracture extending through the base of the olecranon into the cavity of the joint. A portion of quill is passed between the ununited fractured surfaces.

Sub-series C. 65.—The bones of an elbow-joint, exhibiting a recent fracture of part of the olecranon extending into the interior of the joint.

Fracture of the Coronoid Process.

Fracture of the coronoid process is generally the result of a violent contraction of the brachialis anticus muscle. The line of fracture may extend through either the base or the apex of the process; the detached fragment is drawn to some distance from the rest of the bone by the contraction of the brachialis anticus. This injury is generally associated with dislocation of the ulna backwards.

There are no specimens of this fracture in the Museum.

Fracture of the Shaft.

Fracture of the shaft of the ulna is nearly always caused by direct violence, and is less common than fracture of the shaft of the radius, on account of the protected position of the ulna on the inner side of the forearm and its indirect connection with the hand. The fracture commonly occurs in the lower third of the shaft (its weakest part). The upper fragment suffers no displacement, but the lower is drawn outwards towards the radius by the action of the pronator quadratus.

Sub-series C. 81.—An ulna, in which a fracture through the middle of its shaft has been exactly united, but with a small, sharp process of bone growing on its outer side.

III. 85.—Portion of an ulna from an adult, split and detached by a fracture, which was occasioned by the arm being caught in machinery. The fractured portion, about four inches in length, comprises in its whole extent about one half of the circumference of the ulna.

It is remarkable that the bone was splintered to so great an extent longitudinally without the fracture passing at any part through the entire thickness of the shaft. The vacancy left in the bone by the removal of this fragment was filled by granulations, but whether these granulations ossified could not be satisfactorily ascertained.

FRACTURES OF BOTH BONES.

Fracture of both bones may be the result of direct violence, such as a blow or fall upon the forearm, when each bone will be broken

across in the same transverse line; or it may be the result of indirect violence, such as a fall on the hand, when the fracture will occur at a different situation in each bone; the radius, first receiving the shock from the hand, gives way at its weakest part (its upper third), and the shock is then transmitted to the ulna, which likewise gives way at its weakest part (its lower third). The lower fragments are drawn inwards towards each other by the pronator quadratus, whilst the upper fragment of the radius is drawn towards the ulna by the pronator teres.

III. 41.—A radius and ulna which were fractured a considerable time before death.

Sub-series C. 29.—A radius and ulna which have been fractured near their upper ends. The fractures are both firmly united, a large quantity of new bone has been formed around the seats of union. The surfaces of the bony callus on the radius and of that on the ulna, meeting in the interosseous space, have been roughly adapted to each other, but have not coalesced.

Such a condition as the above is best prevented by putting up the fracture with the hand in a position midway between pronation and supination—a position in which the greatest space between the bones is obtained.

Sub-series C. 73.—A radius and ulna, both of which have been fractured about three inches above their carpal ends. The ends of the bones overlapping have united in this position, with a considerable shortening and deflection towards the ulnar side.

III. 95.—Portions of a radius and ulna. Both bones have been fractured, just above their carpal ends, in several directions, both vertically and transversely as indicated by the bristles placed in the soft substance like cartilage, with which the lines of the fracture are filled.

Sub-series C. 128.—A radius and ulna. The first fractured about its middle, the latter at a corresponding point, and also at its lower third.

FRACTURES OF THE CARPUS AND METACARPUS.

The following specimen of fracture of a metacarpal bone is the only example of these injuries in the Museum.

Sub-series C. 108.—Bones of a carpus and metacarpus. The base of the metacarpal bone of the thumb has a widely expanded and flattened surface, by which it articulated with a similarly deformed surface on the trapezium. It is probable that these changes were the consequences of a fracture of the metacarpal bone extending into the joint.

FRACTURES OF THE LOWER EXTREMITY.

FRACTURES OF THE PELVIS.

These are the results of great violence, such as the passage of the wheel of a heavy van over the part. They are generally complicated by injury of the internal viscera. Frequently the sacro-iliac or pubic symphyses are wrenched apart by the force. If the patient does not succumb to injury of the internal organs, union usually takes place. The acetabulum is sometimes fractured from a fall on the hip, giving rise to symptoms of fracture of the neck of the femur.

Sub-series C. 40.—An os innominatum exhibiting fractures radiating from the centre of the acetabulum in various directions through the bone.

Sub-series C. 41.—An os innominatum exhibiting fractures of the acetabulum.

Sub-series C. 87.—Part of the ossa pubis of an adult exhibiting fracture of one of the rami which has been firmly united, but with displacement of the fragments.

III. 56.—A fracture extending through the acetabulum, the result of jumping out of a window.

III. 100 and 101.—Sections of head and neck of femur, with os innominatum of a man in whom dislocation of the femur and fracture of the acetabulum occurred fifty years before death.

III. 62.—Portion of an os innominatum exhibiting an ununited fracture with absorption of bone, in the bottom of the acetabulum. The fracture extended in several directions from the centre of the acetabulum to its circumference.

The fracture was caused by a fall on the trochanter major a few months before death.

Separation of Symphyses.

Sub-series C. 42.—Separation of the pelvic and the sacro-iliac symphyses, from a child.

FRACTURES OF THE FEMUR.

Fractures of the femur may be divided into fractures of the upper end, of the shaft, and of the lower end.

FRACTURES OF THE UPPER END OR NECK.

Fractures may occur through any part of the upper end or neck of the femur. They often extend outwards through the trochanters, but seldom inwards through the articular surface of the head.

As pointed out by Professor Pirrie, the articular surface presents a remarkable difference as to its tendency to disease and its liability to fracture; it is very prone to disease, but is scarcely ever fractured.

Fractures of the neck may be divided into—

1. Intra-capsular fracture.
2. Extra-capsular fracture.
3. Fracture of the great trochanter and separation of the epiphysis of the great trochanter.
4. Separation of the epiphysis of the head.

I. INTRA-CAPSULAR FRACTURE.

Intra-capsular fractures are very common in advanced life, especially in women; they are rare in persons under fifty. III. 50. is a remarkable specimen of this injury in a lad of eighteen.

They are generally caused by indirect and commonly very slight violence, such as slipping off the kerb-stone; they have even been known to occur from catching the foot in the blanket when turning in bed. The chief predisposing causes would appear to be the atrophy and fatty degeneration of the neck of the femur, so common in old people, but the more horizontal position which the neck is believed to assume in old age is regarded by some as an important factor.

STATE OF THE PARTS.

The fracture may occur at any part of the neck within the capsule, and the line of fracture may be transverse or oblique; the cervical reflexion from the insertion of the capsular ligament to the circumference of the head may or may not be torn, and the fragments may be impacted or non-impacted. The capsular ligament is seldom ruptured.

• *Situation and direction of the line of fracture.*

The situation of the fracture is of interest, as upon it depends to some extent the degree of absorption of the neck, and consequent shortening of the limb that will subsequently take place. For, as that portion only of the neck which is in connection with the shaft is absorbed, whilst that in connection with the head remains unaffected, it follows that the nearer the fracture occurs to the head the greater will be the shortening, and *vice versâ*. The direction of the fracture is also of some interest, as it is thought by some authors to determine the everted or the inverted position assumed by the limb after fracture. Thus they maintain, that when the fracture

runs obliquely from before backwards and from without inwards, so that part of the lower fragment is behind the upper, eversion will occur; but when it runs from before backwards and from within outwards, inversion will occur. The fracture is generally transverse, and near the margin of the head.

Sub-series C. 105.—Portions of a femur of which the neck was fractured *transversely* near the *margin* of the head. The whole of the neck remained in connection with the shaft, and has been nearly absorbed.

III. 119.—Portions of the upper part of a femur in which a *transverse* fracture occurred through the *middle* of the neck. The portion of the neck which was connected with the shaft is nearly absorbed; the portion connected with the head *remains*, and its lower margin rests on the trochanter minor and the cancellous tissue within it.

III. 110.—Portion of a femur exhibiting a *transverse* fracture through the neck, *just within* the attachment of the capsular ligament. The portion of the neck which remains connected with the head of the femur is *not* absorbed.

III. 21.—Section of the head and neck of the femur from an aged woman; on the surface of each section a white line is visible which extends obliquely from above downwards and inwards. The line marks a thin layer of fibrous tissue and appears to indicate that a fracture of the neck existed which has been united.

III. 50.—Portion of a femur exhibiting a fracture of its neck. The plane of the fracture extends from the upper margin of the head obliquely through the neck to the outer part of its lower border.

III. 40.—Portion of a femur exhibiting an irregular fracture through the base of the neck.

Condition of the cervical reflexion of the capsular ligament.

The cervical reflexion of the capsular ligament may be completely torn so that all connection is severed between the head and the rest of the bone; or it may be but partially torn, in which case the rent may occur either in front or behind. Upon the extent of rupture will depend not only the amount of displacement of the fragments and consequent shortening of the limb as well as the kind of union which will occur; but also, according to some authors, the everted or inverted condition of the limb. Eversion, it is maintained, occurs when the anterior portion is ruptured, inversion when the posterior. Although it seems quite evident that non-rupture of the anterior part may prevent eversion, it is not so evident how rupture of the posterior part could produce inversion.

III. 18. Portion of a femur, exhibiting a fracture through its neck, just beyond the base of the head. The periosteum and the reflexion of the capsular ligament covering the neck, as is usually the case, are torn

in only the *anterior half* of its circumference: upon the other half the membranes are entire and still connect the two parts of the bone, which may thus, as well as by the mutual adaptation of the uneven surfaces of the fracture, have been held together with very little displacement.

III. 54.—Portion of a femur in which a fracture of the neck within the capsule occurred a short time before death. The cervical reflexion of the capsular ligament and periosteum are torn upon only the anterior part of the neck; upon its posterior part they are entire.

III. 40.—Portion of a femur, exhibiting an irregular fracture through the base of its neck, which occurred about five months before death. The periosteal and cervical reflexion are *torn* upon only the *posterior* part of the neck of the bone; upon its *anterior* part they are *entire*.

The patient, a middle-aged man, fell in the street, and his hip struck against the kerb-stone. Immediately afterwards the limb was *inverted*, and an inch shorter than the other; but no crepitus was felt. In the suspicion that dislocation existed, repeated attempts at reduction were made.

III. 7.—Portion of a femur, exhibiting a vertical fracture of recent occurrence through that part of its neck which is within the capsule. Upon the anterior half of the circumference of the neck of the bone the periosteal and cervical reflexions are torn: upon the posterior half they are entire.

Impaction or non-impaction of the fragments.

In the intra-capsular fracture, impaction takes place by the lower fragment being driven into the upper, *i. e.* the sharp and narrow neck into the round expanded head; in the extra-capsular fracture the neck or upper fragment is driven into the lower, *i. e.* between the trochanters.

In intra-capsular fracture of the humerus, on the contrary, the upper fragment is always driven into the lower, and in the extra-capsular the lower into the upper; *i. e.* the sharper and smaller fragment, whether it be the upper or the lower, is impacted between the tuberosities.

In some cases of intra-capsular fracture of the femur, however, the fragments are mutually interlocked.

The non-impacted variety of intra-capsular fracture of the femur is by far the more common.

III. 110.—Sections of the upper part of a femur fractured almost vertically through the neck, at the base of the head and wholly within the capsule. The neck and upper part of the shaft have been drawn a little upwards, and the lower part of the fractured surface and margin of the neck has been driven tightly into the cancellous tissue of the head. The patient was a very old woman. The fracture occurred about three months before death.

Sub-series C. 115.—Portions of a femur, which was fractured verti-

cally through the neck, at the base of the head, a few weeks before death. The plane of fracture is irregular and the fragments were locked together; so that the principal indications of fracture were absent.

With the exception of the above two, all the specimens of intra-capsular fracture in the Museum are examples of the non-impacted variety.

Condition of the capsular ligament.

The capsular ligament is seldom or never ruptured; but after the fracture has existed some time, it becomes thickened, and otherwise altered by inflammation following the injury.

III. 8.—A hip-joint, exhibiting a vertical fracture of recent occurrence through that part of the neck of the femur which is covered by synovial membrane. The *capsule* is thickened, and a portion of it, which is detached and turned downwards, exhibits inflammatory products upon its internal surface.

III. 23.—A hip-joint, exhibiting fracture of the neck of the femur. The fracture extends vertically through the neck just beyond the base of the head. The *capsule* is much thickened, and the neck of the femur is absorbed.

MODE OF UNION.

Union, when it occurs, is nearly always accomplished by fibrous tissue, very rarely by bone. In the majority of cases, however, no union occurs, the ends of the fragments being merely held together by fibrous bands produced by the thickening of the capsular ligament and its cervical reflexion.

Fibrous union.

By fibrous union is here meant the actual union of the fragments by the interposition of fibrous tissue between the fractured ends, in contradistinction to the mere binding together of the ununited fragments by fibrous bands and thickening of the capsule around them.

III. 22.—Sections of the head and neck of the other femur from the same woman as 21 was taken. A white line is visible on the surface of each section, which extends obliquely from above downwards and inwards. The line marks the section of a thin layer of fibrous tissue, and appears to indicate that a fracture of the neck of the femur has been united by fibrous tissue.

III. 110.—Sections of the upper part of a femur, exhibiting an intra-capsular fracture. The fractured surfaces, without any absorption of the neck, have been united by a thin layer of tough fibrous tissue, which permitted them to be slightly moved on each other.

III. 119.—Sections of the upper part of a femur, in which a vertical fracture occurred through the middle of the neck, within the capsule. The fractured surfaces are united by a thick layer of tough fibrous tissue, permitting a slight degree of motion between them.

Bony union.

Bony union is exceedingly rare; indeed, some authors maintain that it never occurs. The following specimens, however, appear to be undoubted examples of it.

III. 50.—Portion of a femur, exhibiting fracture of its neck. The plane of the fracture is vertical, extending from the upper margin of the head straight downwards through the neck to the outer part of its lower border. Bristles are introduced between the fractured surfaces, which are in close apposition, and it will be observed that the attachment of the capsule to the bones is *entirely beyond* the line of the fracture. That portion of the neck of the bone which remained connected with the trochanters is partly absorbed, and the union of the fractured surfaces, though not complete, is by *osseous matter* inlaid between them.

The individual from whom this specimen was taken was eighteen years of age. In a fall from a cart he injured his right hip; such symptoms ensued as gave rise to the belief that he had dislocated the head of the femur into the foramen ovale. Efforts at reduction were accordingly made. About three months after the injury he died with smallpox.

III. 107.—Sections of the upper part of a femur, from a man aged eighty-two, who was believed to have received a fracture of the neck of this bone two years before death.

"The history of the case is clearly that of fracture of the neck of the femur; the appearances of the bone show that there has been a fracture which has reunited by an osseous medium; and the direction of the fracture is such as, in my opinion, can permit no doubt that it was confined to the portion of the neck of the bone covered by synovial membrane, consequently, that it was wholly within the capsule. The fracture extends through the basis of the head of the bone, in the line of its junction with the neck. As in other cases of the same kind, great part of the neck of the bone has disappeared, and, in consequence, the head is proportionately nearer to the trochanter major and shaft of the bone; its reunion has in fact taken place, in part to the remaining portion of the neck, and in part to the shaft. This union is certainly osseous. In addition to the first maceration of the bone with its surrounding soft parts, it was subsequently immersed for several days in a strong solution of carbonate of potash; and one half of the bone has been boiled in water for three hours without the slightest yielding perceptible in the line of the fracture."

Description of the specimen by Mr. Stanley, in the 'Medico-Chirurgical Transactions,' vol. xxiv, p. 13.

III. 21.—Sections of the head and neck of a femur from an aged woman. On the surface of each section a white line is visible, which extends obliquely from above downwards and inwards, in a plane which would include the base of the neck at its upper part, and the base of the head at its lower part. The line marks the section of a thin layer of fibrous tissue, and appears to indicate that a fracture of the neck of the femur has been united partly by fibrous tissue and partly by bone. The head of the femur is below the great trochanter, and there is an accumulation of bone on the posterior surface of the neck, in a line corresponding with the direction of the presumed fracture.

III. 22.—Sections of the head and neck of the other femur of the same woman. They present the same appearances as those last described, but the line of fibrous tissue is here uninterrupted, while in the preceding it is in some places interrupted by small portions in which the osseous tissue is continuous as if the fracture had in them united by bone.

These preparations were taken from a body supplied for dissection, of which no history could be obtained.

No union.

In the majority of cases no *actual* union of the ends of the fragments takes place, but the neck of the bone becomes absorbed, and the head is merely held in position by fibrous bands produced by the thickening of the cervical reflexion of the capsular ligament, and by the thickened capsule itself. The ends of the fragments either remain rough and uneven; or they become rounded off, polished, and eburnated, and in some cases covered by a layer of fibrous tissue. The space between the trochanters produced by the absorption of the neck frequently becomes modelled into a smooth cup-shaped cavity, in which the rounded extremity of the lower end of the upper fragment freely moves (false joint). Irregular osseous deposits are often produced in these cases around the fractured surface of the head and the space between the trochanters.

III. 19.—A hip-joint, exhibiting fracture of the neck of the femur within the capsule, which occurred many years before death. The neck of the bone is absorbed. Bristles are passed beneath three thick fibrous bands, which extend from the fractured surface of the head of the bone to the capsule. The capsule is generally thickened, and the fractured surfaces are covered by thin smooth layers of fibrous tissue.

III. 49.—Portion of a femur in which fracture of the neck occurred many years before death. The neck of the bone is absorbed: both the fractured surfaces are thinly covered by fibrous tissue; and that of the head has become firmly united to the lower part of the thickened capsule by a broad band of fibrous tissue.

III. 17.—Portion of a femur in which fracture of the neck occurred many years before death. There has been complete absorption of the

neck of the bone. The surfaces of the head and of the space between the trochanters which have been in contact, and which probably moved freely on each other, are very hard, polished, and ivory-like.

Sub-series C. 50.—Portion of a femur, exhibiting fracture of its neck, of which no union has taken place. The neck of the bone is almost completely absorbed, and the surfaces by which the fractured portions were in contact were rough and hard. Deposits of osseous substance have taken place around the base of the head of the femur.

From an old woman, in whom the fracture occurred nineteen years before death.

Sub-series C. 52.—Portion of a femur, exhibiting fracture of its neck, of which there is no union. The surfaces of the head, and of the space between the trochanters which were in contact, are nearly smooth and very hard. Irregular osseous deposits have taken place around the fractured surface of the neck, and upon the head of the bone.

Sub-series C. 113.—The upper part of a femur, fractured at the junction of the head and neck a fortnight before death. The portion of the neck which remains attached to the shaft is much reduced in size, so that it no longer corresponds with the other fractured surface.

There was no shortening or eversion of the limb in this case. The edge of the fractured neck rested against the edge of the acetabulum.

Sub-series C. 105.—Portions of a femur, of which the neck was fractured, near the margin of the head, many years before death. The remains of the neck have been nearly absorbed. The fractured surface of the head is adapted to the surface of the short portion of the neck which remains between the trochanters, and to a growth of bone proceeding from it downwards. Both the surfaces thus adapted are very hard, polished, and ivory-like.

Sub-series C. 76.—Portion of a femur with the acetabulum, exhibiting a fracture of the neck of the femur, which occurred fifteen years before death. The neck of the bone is absorbed. The opposite surfaces of the head and shaft, which have been in apposition, are covered by a layer of hard osseous substance. There is a considerable deposit of new bone at the bottom of the acetabulum, and upon the head of the femur.

The signs of fracture of the neck of the femur were not presented till six weeks after the injury, and two weeks after the patient had begun to walk on crutches.

Intra-capsular fracture simulated by chronic rheumatic arthritis.

Care must be taken to distinguish chronic rheumatic arthritis of the hip-joint, which is frequently accompanied by depression and shortening of the neck of the femur, from intra-capsular fracture united by bone. In chronic rheumatic arthritis the head of the femur is smooth, polished, eburnated, flattened, and surrounded by nodular, flat osteophytes, and the neck on section presents no indications of fracture having occurred.

Sub-series C. 78.—Portion of a femur, exhibiting a depression and shortening of the neck, with flattening of the head, and formation of bone around its margin.

From an aged person. It was believed, from the circumstances of the case, that the neck of the femur had been fractured in a fall; but there are no indications of a fracture having been united.

II. EXTRA-CAPSULAR FRACTURE.

Extra-capsular fractures are generally caused by direct violence, such as a severe blow or a fall upon the great trochanter. Though more frequent in the old than in the young, they are not, like intra-capsular fractures, essentially an injury of old age; thus, they are frequently met with between the ages of forty and fifty, whereas intra-capsular hardly ever occur in persons under fifty.

Several varieties of extra-capsular fracture occur. They may be divided into the impacted and non-impacted.

The impacted.

This form is by far the more common, and is nearly always associated with fracture through the great trochanter. Indeed, Dr. R. W. Smith believes that all extra-capsular fractures are in the first instance impacted and accompanied by fracture through the trochanter. Specimens, however, of extra-capsular fracture unaccompanied by either of these conditions are occasionally met with.

The many minor differences which exist in the impacted variety are comprehended under the three following types.

In the first and most common, the neck is fractured through its base and driven between the trochanters, detaching more or less of the great trochanter from the bone, as in—

III. 11.—Portion of a femur. A fracture extends through the base of the neck and obliquely through the trochanter major, detaching the posterior and upper part of that process from the shaft.

The line of fracture through the trochanter varies slightly in different specimens; it commonly extends from near the anterior part of the upper border of the trochanter major obliquely backwards and downwards over its outer surface, and terminates by passing through the trochanter minor.

This typical direction is well seen in the above specimen, and in III. 14, 15, and several others.

III. 14.—Portion of a femur, exhibiting an extra-capsular fracture of its neck. Two distinct lines of fracture may be traced, one across the base of the neck, the other passing obliquely through the trochanter major and trochanter minor.

Slight variations in the line of fracture are seen in the following—III. 16, 76, and Sub-series C. 57.

In the second and much less common type, the neck is fractured through the base and impacted between the trochanters, but the trochanters themselves are not fractured.

III. 77.—Section of the upper part of a femur from an old woman exhibiting an impacted extra-capsular fracture *unaccompanied by fracture of the trochanters*. The base of the neck is in great part absorbed,

Sub-series C. 67.—Portion of a femur, exhibiting a fracture through the base of the neck. The lower margin of the fractured neck is impacted into the cancellous tissue between the trochanters, but no sign of fracture is visible where the upper margin of the neck joins the trochanter major.

Specimens resembling the one last described have been considered by some as examples of partial fractures, *i. e.* that the lower part of the neck has been fractured, the upper merely bent. Others, however, deny the existence of partial fracture altogether, and consider, with the author, specimens like the above, examples of complete fracture, in which, while the lower portion was impacted, the upper remained in accurate apposition, and has united, without trace of callus, by the rare process of immediate union. See also Sub-series C. 56 and 57. In 57, however, the great trochanter seems to have been fractured.

In the third type the neck is fractured through its base and impacted between the trochanters, splitting the trochanter major into several pieces.

Sub-series C. 131.—A femur, exhibiting an extra-capsular fracture; one line of fracture extends through the base of the neck, the other through the trochanter major, splitting it into several fragments. See also Sub-series C. 54.

The non-impacted.

Non-impacted extra-capsular fractures are rare. Dr. R. W. Smith says that they only occur as the result of great violence, and that they are always accompanied by fracture through the trochanter. For, believing as he does that all extra-capsular fractures are at first impacted, he maintains that they can only become non-impacted by the splitting asunder of the parts of the trochanter between which the neck is wedged, in consequence of the neck being driven in still further, wedge-wise, between the trochanters.

There is no specimen of the non-impacted variety of extra-capsular fracture in the Museum.

Mode of union.

Union in extra-capsular fractures is generally bony, and thus differs materially from that in intra-capsular, which is nearly always fibrous. In rare instances where the parts are in accurate apposition, immediate union, without the intervention of callus, occurs, similar in all respects to the immediate union of soft parts. In other instances bony callus is produced, consolidating the fractured portions. Or, again, the fractured portions of the trochanter may become united so as to form a cup-like depression, in which the neck of the femur rests, the neck itself either being united to the excavated surface of the trochanter by fibrous tissue, or remaining totally disunited, in which case the opposed surfaces become evenly ground down by mutual friction, so giving rise to a species of false joint.

Immediate union.

Sub-series C. 67.—Portion of a femur, in which a fracture is believed to have occurred many years before death through the base of its neck. The fracture (if one happened) has been completely repaired, for its direction is not indicated by any line in the cancellous texture. See also Sub-series C. 56, 57, and 78.

Sub-series C. 96.—Portion of a femur, in which there appears to have been a fracture extending vertically through the base of the neck. The fracture has been completely repaired, but with such a displacement of the head and neck that they form a right angle with the shaft, and are depressed below the summit of the trochanter major.

The displacement seen in this specimen is a very common one; it is produced by the drawing up of the shaft by the action of the muscles inserted into the trochanters.

Union by intermediate callus.

III. 12.—Portion of a femur, in which there has been a fracture of the neck and of the upper part of the shaft. The head and neck of the femur are driven downwards and impacted into the cancellous tissue between the trochanters; and in this position the fractured portions are firmly united. See also III. 10.

By much callus around fragments.

Sub-series C. 51.—Section of a femur, in which there has been a fracture extending through the base of its neck, and through its shaft between the trochanters. There is firm union of the fractured surfaces, with shortening of the neck and an apparent descent of it below its natural situation. The union has taken place with a great accumulation of bone about the line of fracture.

Sub-series C. 49.—Portion of a femur, in which there has been

fracture extending through the base of its neck and obliquely through the base of the trochanter major. The fractured surfaces have firmly united, but the shaft has been drawn upwards and forwards, so that the head and neck of the femur appear much below their natural situation. In this position a bridge of bone has united the base of the head of the femur to the margin of the posterior inter-trochanteric ridge.

Trochanters united by bone, forming cup-like depression for neck. Neck united by fibrous tissue to surface of the cup.

III. 76.—Section of a femur, exhibiting an extra-capsular fracture. The fracture extends through the base of the neck and upper part of the great trochanter. The neck was driven into the upper part of the shaft between the trochanters. In this situation a layer of compact bone has been formed on the whole of the broken surface of the cancellous tissue of the shafts and trochanters, in such a manner as to form a smooth excavation in which the neck of the femur rests. To this excavated surface the neck of the femur, itself also covered by compact bone, was connected by ligamentous tissue. The fracture through the trochanter is completely united by bone.

III. FRACTURE OF GREAT TROCHANTER AND SEPARATION OF EPIPHYSIS OF GREAT TROCHANTER.

No specimen in the Museum.

IV. SEPARATION OF EPIPHYSIS OF HEAD.

This can only occur in the young, *i. e.* before the epiphysis has united with the shaft. There is no specimen in the Museum.

FRACTURES OF THE SHAFT.

Fractures through the shaft of the femur are generally the result of indirect violence, occasionally of direct, and in rare instances of muscular action.

The fracture may be transverse or oblique in direction, and may occur in the upper, middle, or lower third of the shaft.

Upper third.

In fractures through the upper third the upper fragment is usually tilted upwards and forwards by the psoas and iliacus, causing a swelling in the groin; at the same time it is slightly everted and abducted by the external rotators and glutei. The lower fragment is generally drawn upwards by the muscles proceeding from the pelvis to the shaft below the fracture, *i. e.* by the rectus and hamstrings. It is likewise adducted and rotated slightly outwards by the adductors. Union usually occurs with a considerable overlapping of the upper fragment.

Although the above described is the common form of displacement, almost any may occur.

Sub-series C. 58.—The bones of a knee-joint. There has been a transverse fracture through the lower third of the shaft of the femur above the condyles. The upper end of the bone, protruded downwards into the popliteal space, has, in this position, become firmly and extensively united to the condyles. There is a complete osseous ankylosis of the patella to the femur, and of the condyles of the femur to the head of the tibia.

Sub-series C. 8.—Portions of a femur fractured in two places by a wheel passing over the limb. One fracture is about one third from its upper end, and the other at the same distance from its lower end.

FRACTURE OF THE LOWER END.

Fracture through the lower end or condyles necessarily involves the knee-joint. The line of fracture generally extends in several directions; in most cases it runs transversely through the lower end of the shaft, just above the articular surfaces of the condyles, and vertically or obliquely between the latter into the knee-joint. The lower end of the upper fragment is frequently impacted between the separated condyles. In young subjects the fracture is apt to occur in the line of the epiphysis. Fracture through the condyles frequently leads to destructive inflammation of the knee-joint. The union of the fracture between the condyles is accomplished by fibrous tissue.

Sub-series C. 12.—Portion of a femur which has been fractured in its lower part. The fracture extends transversely through the shaft, and obliquely between the condyles into the knee-joint. The lower end of the shaft is driven in between the displaced and separated condyles.

Sub-series C. 13.—Portion of a femur fractured in its lower part. The fracture extends in several directions through the lower third of the shaft a little above the condyles, and downwards between the condyles into the knee-joint. Several small pieces of bone were completely detached.

Sub-series C. 15.—Portion of a femur, fractured in exactly the same manner as C. 13.

Sub-series C. 9.—Portion of a femur which has been fractured transversely through the middle of the shaft, and in which there is an extension of the fracture downwards through the lower half of the shaft and through the internal condyle.

Sub-series C. 14.—Portion of a femur fractured transversely into many small pieces just above the condyles. From inflammation in the knee-joint there has been deep and extensive ulceration of the articular surfaces of the condyles of the femur and the head of the tibia.

III. 34.—A knee-joint, exhibiting the consequences of a fracture in the lower part of the femur. The fracture extended transversely through the shaft a little above the condyles, and downwards between the condyles into the joint. The upper portion of the bone was forced

downwards by the side of the patella, and a few days after the fracture, it protruded through the integuments, and could not again be replaced. In this situation it has become firmly fixed by bone to the condyles and the lower part of the shaft. An inch and a half of the protruding portion of the femur perished, and its separation from the living bone had commenced; a shallow groove is formed between them. The articular surfaces of the knee-joint are ankylosed.

SEPARATION OF THE CONDYLES OF THE FEMUR THROUGH THE
LINE OF THE EPIPHYSIS.

Sub-series C. 42.—A pelvis and the lower portion of a femur, from a boy fourteen years old. The condyles of the femur have been separated from the shaft at the line of their epiphytic union. The sacro-iliac symphysis and symphysis pubis have also been separated by the violence.

III. 91.—Portion of a femur, exhibiting a separation of its shaft from the lower epiphysis, and a fracture extending between the condyles into the knee-joint. The violence of the injury has also occasioned the stripping off of the periosteum from the shaft of the femur to the extent of many inches, and the shaft protruded through the muscles on the inner side of the thigh. Parts of the periosteum, which were stripped from the shaft, remain attached to the condyles. From a boy aged sixteen. The injury was produced by a rope entangled round the leg.

FRACTURES OF THE PATELLA.

Fractures of the patella are generally caused by muscular action, the bone being snapped across by a sudden contraction of the quadriceps extensor muscle, such as is exerted by a person in the attempt to regain his erect position when he feels himself slipping backwards. They are also caused by direct violence, such as a blow or fall upon the knee.

The direction of the fracture when due to muscular action is transverse; when due to direct violence generally vertical or starred, or, in rare instances, transverse. The amount of displacement depends upon the direction of the fracture and the integrity of the aponeurotic and periosteal coverings of the bone. When the fracture is transverse and the aponeurotic coverings are much torn, the upper fragment will be drawn some distance from the lower by the action of the quadriceps extensor, while the lower is held in position by the ligamentum patellæ; but when the aponeurotic coverings are but little torn, or altogether uninjured, little or no separation occurs. When the fracture is vertical or starred the aponeurotic coverings are seldom torn, and hardly any separation of the fragments takes place.

Method of union.—This will depend upon the condition of the fragments. In transverse fracture from muscular action, in which the aponeurotic coverings are generally torn and the fragments much separated, the union will be either ligamentous or membranous, according to the amount of separation, but in those rare instances of transverse fracture from direct violence, where the aponeurotic coverings are but little injured, and the fragments consequently remain nearly in apposition, true bony union may occur.

In the vertical and starred fractures, where the fragments are usually but little separated, bony union may be said to be the normal method of repair.

FROM MUSCULAR ACTION.

I. *Ligamentous or fibrous union.*

III. 30.—Section of a patella, in which there has been a transverse fracture. The fractured surfaces are united by a thick portion of ligament about an inch in length, which is smoothly lined, as if by a continuation of the synovial membrane.

III. 72.—Two portions of a fractured patella, which were united by fibrous or ligamentous substance. The lower portion is much enlarged and altered in form by the deposit of osseous substance upon its borders.

III. 132.—A patella divided longitudinally. It had been fractured transversely during life, and the separated portions have been united by ligamentous or fibrous tissue.

III. 141.—Section of a patella that has been fractured transversely. There is no bony union, and no production of new bone. The surfaces of the fracture have undergone but little change. In consequence of the insertion of the extensor tendon and ligamentum patellæ chiefly into the free and external surface of the bone, the fragments have been drawn asunder to a greater extent externally than at their articular surfaces; so that a wedge-shaped interval exists which in front measures one inch and a half; towards the joint surface only six tenths of an inch. Ligamentous material has been produced from the whole of both fractured surfaces; but in front this has undergone stretching, while towards the surface it constitutes a strong, thick, and wide connecting band between the fragments.

II. *Membranous union.*

III. 28.—Two patellæ from the same person. Both bones have been fractured transversely. The fractured portions of each, having been separated to a distance of five inches from each other, are connected only by a thin aponeurotic membrane. The fragments are all, but not equally, enlarged.

III. 123.—A knee-joint from a person who fractured the patella many years before death, and recovered complete use of the limb,

although no union of the fragments took place. The portions of the patella separated by transverse fracture are about four inches apart in the nearly extended position of the joint; their broken surfaces are turned obliquely forwards and are smooth, and thinly covered with fibrous tissue; their posterior borders are tightly connected with the synovial and fibrous capsules of the joint, and these hold them in their places; there is no direct or new-formed bond of union between them.

FROM DIRECT VIOLENCE.

I. *Bony union—common.*

III. 108. A patella, fractured in three lines radiating from the centre to the circumference. The portions are completely and closely united by bone and with very little displacement, the lower portion alone being pushed somewhat forwards. Some new bone is deposited along the lines of fracture on the anterior surface of the patella; the posterior surface is smooth, and presents no new bone; the margin of one of the fractures has still the appearance of a fracture of recent occurrence.

It is probable that the fracture was caused by a blow upon the patella.

III. 52.—A patella, in which a vertical fracture occurred a short time before death. The tendinous covering of the anterior surface of the bone is entire. *Union of the fracture has not yet commenced.* The articular cartilage is in part absorbed, but this had, probably, occurred before the fracture.

III. 105.—A patella, which has been fractured transversely near the attachment of the ligamentum patellæ. A part of the line of fracture still remains open; but in another, and smaller part, the two portions are smoothly united by firm and healthy bone.

II. *Ligamentous union—rare.*

III. 29.—Section of a patella which has been fractured into three pieces. The portions are united by a thick ligamentous substance and are all enlarged; the upper fragment alone is as large and has the same form as an ordinary adult patella.

III. 26.—A patella, with a small piece of bone, which had probably been broken off, and is now connected by ligament with its lateral border.

FRACTURES OF THE BONES OF THE LEG.

Fractures of the leg may be divided into—fractures of both bones, fractures of the tibia alone, and fractures of the fibula alone. Of these, fractures of both bones are by far the most common.

FRACTURES OF BOTH BONES.

Fracture of the tibia and fibula may be caused by direct or indirect violence. When the result of direct violence, the fracture

- may of course occur at any part; when the result of indirect, only at the weakest part. Both bones may be fractured in the same transverse line, but more commonly the fibula is fractured higher up the shaft than the tibia.

The line of fracture may be transverse or oblique. In the former case but little displacement occurs; in the latter the lower fragments are generally drawn backwards, upwards, and a little outwards, the line of fracture commonly extending downwards, forwards, and a little inwards. Fracture of the lower end of the tibia, combined with fracture of the fibula a few inches above the external malleolus, is a common variety of fracture of both bones.

Fracture of both bones in the same transverse line.

Sub-series C. 110.—A tibia and fibula, which were fractured somewhat obliquely near the middle of their shafts. The several portions are firmly united, but with lateral displacement, both the lower fragments being placed on the outer side of the upper ones.

Sub-series C. 97.—A tibia and fibula, fractured through the middle of their shafts. The fractures are firmly united, but with displacements of the fragments, so that in each bone there is a considerable angle directed inwards.

Sub-series C. 91.—Section of a tibia and fibula, fractured through the middle of their shafts; the fractures are consolidated. There is also lateral union of the two bones, and an abundant deposit of new bone above and below the seat of fracture.

Sub-series C. 18.—Portions of a tibia and fibula, the shafts of which were fractured obliquely about three inches above the ankle. The fractures have been firmly united, but with displacement, the lower portion of the tibia having been carried towards the fibula.

Fracture of both bones, but in different situations.

Sub-series C. 1.—A tibia and fibula. The tibia has been fractured in its middle, and the fibula near its upper end. Both fractures are firmly united, with displacement and overlapping of the fractured ends, so that the tibia at the seat of fracture forms an angle directed backwards, and the fibula an angle directed outwards. Both the bones are also atrophied, and very slender.

Sub-series C. 3.—A tibia and fibula. The tibia has been fractured about one third from its lower end, and the fibula near its upper end. Both fragments are firmly and smoothly united, but with a slight lateral displacement, the lower fragments converging in the interosseous space.

Fracture extending into ankle-joint.

Sub-series C. 17.—Portions of a tibia, fibula, and the astragalus. Both the tibia and the fibula were fractured about three inches above the malleolus, and the fracture of the tibia extends downwards into the ankle-joint. The fractures are all firmly united with little displace-

ment, but with much thickening and induration of the bones, and with osseous union of the tibia and fibula, and of both of them to the astragalus.

Sub-series C. 22.—Portions of a tibia and fibula. There is a comminuted fracture of the tibia about two inches above the ankle, and two lines of fracture extend downwards into the ankle-joint. The fibula is fractured about four inches above the ankle.

Sub-series C. 88.—Portions of a tibia and fibula. Fractures extend in several directions through the shaft and articular end of the tibia into the ankle-joint. The fibula also is fractured through the base of the malleolus.

FRACTURES OF THE TIBIA.

Fracture of the tibia alone may be caused by direct violence; or by indirect violence, such as a fall upon the foot, when the tibia, receiving the shock transmitted from the foot, gives way at its weakest part, in the same manner as the radius from a fall upon the hand. The fracture is usually situate at the lower part of the bone, and is generally transverse and accompanied by but little displacement, the fragments being held in position by the fibula which plays the part of a splint. Fracture may also occur through the lower end and extend into the ankle-joint, in which case the lower fragment along with the foot may be displaced. Fracture of the upper end extending into the knee-joint also occurs. In the young separation of the lower epiphysis has been recorded.

Middle of shaft.

Sub-series C. 109.—A tibia, which was fractured very obliquely through the middle of its shaft. The fractured portions are firmly united, and so exactly that on the posterior aspect of the bone the line of fracture is not discernible. The shaft in the neighbourhood of the injury is thickened, and new bone is deposited on many parts of its surface.

Sub-series C. 2.—A tibia, fibula, and astragalus. The tibia has been fractured at the junction of the upper and middle thirds of its shaft. Its two portions, displaced laterally, have been firmly united. The fibula, in adaptation to the altered form of the tibia, to which also it is united by two bridges of new bone, is bent and flattened, as in rickets.

Fracture extending into ankle-joint.

III. 44.—The lower extremities of a tibia and fibula. A recent fracture extends through the articular surface and cartilage of the tibia. The communication of this fracture with the ankle-joint is closed by a thin layer of inflammatory material, firmly adhering to all the parts of the articular cartilage through which the fracture extends.

Sub-series C. 66.—Bones of an ankle-joint, exhibiting a double

fracture of the internal malleolus, separating it from the tibia and splitting it into two portions.

FRACTURES OF THE FIBULA.

Fractures of the fibula may be caused by direct or indirect violence. When due to direct violence the fracture necessarily occurs at the seat of injury; when due to indirect violence, such as a twist of the foot outwards or inwards, the fracture occurs three or four inches above the external malleolus. When the fracture is the result of an outward twist (*Pott's fracture*) the foot is usually dislocated outwards, the external lateral ligament is intact, and the internal ligament is ruptured, or the internal malleolus is torn off, the ligament remaining intact. When it is the result of an inward twist of the foot, the external lateral ligament is intact, but an outward angle is formed at the seat of fracture, and the internal malleolus is fractured or the internal lateral ligament ruptured.

Fracture of the Shaft.

Sub-series C. 75.—Section of a fibula, in which there has been a comminuted fracture about two inches above its lower end. A fragment of bone, which was separated, is firmly united to the external surface of the upper and lower portions of the shaft. The fractured ends of the shaft are not yet united, but the fragment just mentioned, being united to both, holds them together. The fracture occurred five weeks before death.

Fracture of lower end (Pott's fracture).

Sub-series C. 107.—The lower extremities of the tibia and fibula, with the foot, of an elderly woman, exhibiting the effects of an injury which occurred several years before death. The foot is dislocated outwards, so that only the outer half of the articular surface of the tibia is in apposition with the astragalus. There has been a comminuted fracture, extending in various directions through the lower end of the fibula and the adjacent margin of the tibia. The separated portions of bone have been completely re-united.

Sub-series C. 69. — A foot, with parts of the tibia and fibula, exhibiting the effects of fracture and dislocation ten months before death. The foot is dislocated outwards, and the tibia is partially separated from the fibula; the internal malleolus projects an inch on the inner side of the astragalus. The astragalus also is partially separated from the navicular bone. The fibula has been broken into several pieces just above the malleolus. These portions are firmly re-united, and there is an accumulation of bone both before and behind the articulation between the tibia and fibula.

The patient was a lunatic, forty years old. The dislocation was not reduced till a month after its occurrence, and the patient's restlessness prevented the tibia from being maintained in its proper place; but he finally regained complete use and power of the foot.

Sub-series C. 39.—Portions of a tibia and fibula. The point of the internal malleolus has been separated by fracture. The fibula is broken two inches above its lower end.

FRACTURES OF THE BONES OF THE TARSUS.

Fractures of the tarsal bones are rare; they are for the most part the results of great violence; they generally occur either in the os calcis or astragalus, the smaller tarsal bones being almost exempt from fracture. The posterior part of the os calcis may be broken off by muscular action, the bone yielding instead of the strong tendo Achillis.

Fracture of os calcis.

Sub-series C. 90.—The foot of a child, exhibiting a partial dislocation of the astragalus from the os calcis, together with a fracture of the superior and anterior margins of the latter bone, in consequence of the passage of a carriage-wheel over the foot.

Sub-series C. 126.—A comminuted fracture of the os calcis.

III. 9.—An os calcis, fractured transversely through its posterior part. The plane of the fracture extends from the posterior border of the upper articular surface to the middle of the posterior surface of the tuberosity.

The patient fell from a height, but did not strike his heel. It appears certain that the fracture of the os calcis was produced by the action of the muscles of the leg.

GUNSHOT INJURIES.

Gunshot injuries of the bones are rare in civil practice. The following are the only specimens of these injuries in the Museum:

III. 37.—Portion of a sternum, fractured upon its internal surface by a bullet, which has become firmly embedded in the surface of the bone and in new bone deposited so as to form a shallow pit beneath it.

Sub-series C. 119.—A right innominate bone; on the outer side of the ilium is a large circular aperture, and around it are many indentations, in some of which the shot producing them are seen impacted in the osseous tissue. From a boy, who died sixteen days after having been accidentally shot. A probe introduced along the track of the shot detected bone denuded of periosteum; it being suspected that pus had formed on the pelvic aspect of the ilium, the surface of that bone was exposed, and the opening, conspicuous in the preparation, was made with the trephine.

Sub-series C. 123.—Part of a femur, from the body of a Russian whose limb was carried off by a round shot at the battle of Chernaya.

Sub-series C. 132.—A skull. Through the squamous portion of the right temporal bone, at its junction with the parietal, a bullet has passed.

CHAPTER III.

DISEASES OF JOINTS.

SYNOVITIS.

SYNOVITIS is the name given to inflammation of the joints beginning in the synovial membrane. It may be acute or chronic.

ACUTE SYNOVITIS.

Acute synovitis is generally the result of exposure to cold and damp, or of an injury, such as a sprain or blow ; it may also arise from constitutional causes, such as rheumatism, gout, gonorrhoea, or pyæmia.

In the early stages the synovial membrane is red and injected, and the synovial fluid slightly increased in quantity. Later, the membrane loses its shiny appearance and becomes infiltrated and slightly thickened, and the fluid turbid from admixture with inflammatory products. In the majority of cases the inflammation, after having reached this point, subsides, the effused fluid is absorbed, and the synovial membrane assumes its normal appearance. If, however, resolution does not occur, the inflammation either passes into the chronic form, or runs on to destruction of the joint. Under the latter circumstances the synovial membrane becomes more intensely injected, swollen, and infiltrated, and pus is formed in its tissues and in the cavity of the joint. The inflammation spreads to the cartilages, which are rapidly destroyed, and the bone beneath becomes superficially ulcerated. The capsular and other ligaments are softened and stretched, allowing the articular surfaces to be more or less separated by the action of the muscles. The surrounding soft tissues are infiltrated with the inflammatory material, which, breaking down in places into pus, gives rise to periarticular abscesses.

Should the patient survive this total disorganization of the joint, the pus and other inflammatory products make their escape externally, the contiguous ulcerated surfaces of the bones become covered with granulations, which subsequently unite, and after

passing through a stage of fibrous tissue, undergo ossification, leaving the patient with a stiff joint (bony ankylosis). The muscles, which normally act upon the articulation, undergo partial atrophy and fatty degeneration from want of use.

In pyæmia, and in some forms of synovitis in children, the inflammation runs an extremely rapid course, and the joint may be found distended with pus in a few hours.

The successive changes in the synovial membrane, cartilages, bones, and structures surrounding the joint, should next be studied in detail by the aid of the following specimens.

Changes in the synovial membrane.

a. Increased vascularity and slight swelling of the synovial membrane. Effusion of serum into the cavity of the joint.

No specimen.

b. Intense vascularity and great swelling of the synovial membrane from inflammatory infiltration. Formation of pus in the cavity of the joint.

I. 123.—A knee-joint. The synovial membrane is very vascular and is covered upon its internal surface by inflammatory products. The inflammation was the result of necrosis of a portion of cancellous tissue in the head of the tibia.

Changes in the cartilages.

a. Invasion of the cartilage by the blood-vessels of the synovial membrane and of the underlying bone. Opaque white appearance and loss of translucency and smoothness of the cartilages.

II. 45.—A knee-joint. The synovial membrane is thickened and increased in vascularity. The encroachment of the vessels of the synovial membrane upon the cartilages is well seen. Upon the patella, as well as upon the outer condyle of the femur and head of the tibia, the free surface of the articular cartilage is extensively destroyed. The patient was a boy aged fifteen. The disease had been only of two months' duration.

b. Destruction of portions of cartilage; the margins of the remaining portions either abrupt and smooth, as if cut by a chisel, or thinly prolonged over the surface of the bone.

II. 2.—An astragalus, from the superior articular surface of which, nearly all the articular cartilage has been removed; a small portion remains closely adherent to the bone, and very thin. The exposed surface of bone is healthy, except at one small portion, which is superficially ulcerated.

II. 9.—A patella, from which nearly all the articular cartilage has

been removed by ulceration. The ulceration appears to have extended from the free surface towards the bone; the margins of the remaining peripheral part of the cartilage are either abrupt and smooth, as if cut with a curved chisel, or, in parts, thinly prolonged over the surface of the bone. All the cartilage that remains has retained its natural firm connection with the bone. The part of the surface of the patella which is exposed by the ulceration of the cartilage is itself superficially ulcerated.

II. 32.—The articular portions of a femur and patella, exhibiting partial destruction of the articular cartilages and loosening of their connection with the bones. The cartilage upon the patella has been destroyed in its centre, and it was readily separable from the bone, except at its border where it still maintains its natural firmness of connection. Upon the posterior part of the condyles of the femur, the whole thickness of the cartilage is destroyed: the exposed surface of the bone is rough and very vascular.

On microscopical examination the above-mentioned changes in the cartilages, which were formerly spoken of as ulceration, are seen to consist in the growing into the cartilage of capillary blood-vessels from the synovial membrane and bone; in the enlargement of the cartilage-capsules; in the multiplication and escape of their cellular contents; and in the softening and liquefaction of the matrix.

Changes in the bones.

a. Superficial ulceration of the surfaces exposed by the destruction of the cartilages.

II. 4.—An ankle-joint, from which nearly all the articular cartilages have been removed; the small portions which remain are thinned, and their connection with the bones is loosened. The bones are superficially ulcerated and very vascular. The posterior surface, by which the astragalus articulated with the os calcis, is similarly diseased.

II. 14.—A hip-joint. The cartilages have been completely separated from the head of the femur and from the acetabulum, and some shreds and remnants of it are loose in the cavity of the joint. The exposed bones are superficially but smoothly ulcerated.

The patient was a sailor, forty years old. Inflammation of the joint was the result of a fall upon the hip.

The changes which occur in ulceration of the articular surfaces of bone will be found described in detail under "Simple Caries," page 13.

b. Partial or complete dislocation of the articular surfaces from muscular contraction. Softening and elongation of the ligaments.

II. 55.—A knee-joint, in which the tibia has been dislocated backwards and outwards. The external and internal lateral ligaments retain their normal attachments, but are much elongated.

c. Formation of granulations on the contiguous surfaces of the affected bones; union of the two layers of granulations; transformation of the united layers into fibrous tissue and bone (bony ankylosis).

II. 99.—Section of a knee-joint, the articular surfaces of which are united by fibrous tissue and bone. The patella is united to the inferior part of the outer condyle of the femur, and their respective cancellous tissues have coalesced. The tibia and fibula are drawn backwards under the femur. The external lateral ligament is changed in its direction and is elongated.

The other section of the joint is preserved in the next Sub-series, B. 41.

d. Formation of new bone in the form of stalactitic spicula under the periosteum around the ulcerated articular surfaces.

II. 30.—Bones of an elbow-joint, exhibiting the effects of inflammation, which probably commenced in the joint. The texture of the bones has become porous and spongy, their articular surfaces are ulcerated, and upon the external surface of each bone there is an irregular deposit of new bone in ridges and sharp processes.

Compare these stalactitic formations with the nodular osteophytes of chronic rheumatic arthritis.

Changes in the parts around the joint.

a. Thickening, softening, and ulceration of the capsular and other ligaments; formation of abscesses around the joint.

II. 19.—A hip-joint, in which the articular cartilage covering the acetabulum and head of the bone is completely destroyed. The exposed surfaces of bone are ulcerated, and the acetabulum is thereby enlarged. The ligamentum teres is also in great part destroyed; but shreds of it remain, and retain the connection of the bones. The capsule is thickened, and its inner surface is thinly lined by inflammatory products.

Acute inflammation of the synovial membrane may also follow wounds of the joint (III. 126), the bursting of an abscess into a joint (II. 58), the spread of suppuration from the neighbouring parts (II. 45), necrosis of the cancellous tissue (I. 123), acute necrosis (II. 216), osteo-myelitis, or osteitis. In all of these cases, however, the inflammation usually affects at the same time the capsule and other parts entering into the formation of the joint, and is by some authors spoken of as acute arthritis. As the changes, however, which occur in the various structures are similar to those above described, except that they do not follow one another in the same order, a separate description of so-called acute arthritis has not been thought necessary.

CHRONIC SYNOVITIS.

Chronic inflammation of the synovial membrane may be the sequel of acute synovitis, or it may be traced to a sprain or other slight injury, or to rheumatism, exposure to damp, and such agencies. Chronic synovitis occurring in so-called strumous subjects will be described under strumous disease of the joints.

On opening the joint the synovial membrane is seen slightly thickened, and the synovial fluid increased in quantity but the cartilages are but little if at all affected. The inflammation may terminate in resolution or in an acute attack.

The well-known condition of the joints, formerly called *hydrops-articulæ*, in which the synovial membrane is greatly distended by clear serous fluid, but is little if at all altered in structure, is thought by some to be of the nature of chronic synovitis. Many assert, however, that it is of non-inflammatory origin, and merely a passive effusion into the joint depending upon the loss of balance between the absorbing and secreting action of the synovial membrane. The affection, which is unattended by pain or other inconvenience except the weakness it occasions in the joints, may last for years. There are no specimens in the Museum.

STRUMOUS DISEASE.

Strumous disease, also called tumor albus, white swelling, fungous inflammation, &c., is characterised by a gradual and uniform enlargement of the joint, unaccompanied by redness or much increase of synovial secretion. The term strumous, although open to the objections that the disease occurs in other than strumous subjects, and that the term itself is vague and not easy of definition, has been here retained as that by which the disease in question is perhaps best known.

The affection generally begins either as a low form of chronic inflammation of the synovial membrane, or as strumous caries of the articular ends of the bones. Occasionally it appears to begin in the ligaments.

By Cornil and Ranvier it is believed to depend upon a fatty degeneration of the cellular elements of the cartilage.

BEGINNING IN THE SYNOVIAL MEMBRANE—STRUMOUS SYNOVITIS.

The synovial membrane, which at first appears red and swollen, gradually becomes thickened and œdematous, and ultimately pulpy, gelatinous, fatty-looking, and indistinguishable from the capsule and surrounding parts. The synovial fluid is but little increased

in quantity, and is generally muco-purulent. The synovial tufts, at first soft and flocculent, gradually assume the form of granulations, and "grow over the cartilage from the sides till they cover it completely, lying upon it like a veil." Prolongations from this veil of granulations, compared to roots of ivy penetrating a wall, insinuate themselves into and spread in all directions through the cartilage, which they ultimately destroy, and then in like manner invade the bone, setting up strumous caries. (Billroth.)

It has been recently affirmed, that the inflammation of the synovial membrane is preceded by the formation of miliary tubercles in the membrane itself.

Fungous granulations invade the tissues around the joint, and, softening down in places into pus, give rise to abscesses, which may open both externally and into the cavity of the joint. The ligaments become softened and destroyed, allowing the articular surfaces to be dislocated by the contraction of the muscles. The muscles and bones, partly from want of use, and partly from the debilitating nature of the disease, undergo atrophy and fatty degeneration.

Should the patient survive this total disorganization of the joint, the abscesses and sinuses heal, granulations form upon the ulcerated articular surfaces of the bones, the two layers of granulations unite, and osseous or fibrous ankylosis ensues, leaving the patient with a stiff joint.

The above-mentioned changes in the synovial membrane, cartilages, bones, and surrounding parts, should next be studied in detail by the aid of the following specimens:

Changes in the synovial membrane.

a. Swelling and redness of the synovial membrane; the synovial tufts puffed up, elongated, soft, and succulent; the synovial fluid slightly increased in quantity, cloudy, and muco-purulent. (Billroth.)

No specimen.

b. Thickened, softened, and cedematous condition of the synovial membrane from inflammatory infiltration; villous-like appearance of its internal surface; and encroachment of the synovial tufts in the form of granulations upon the cartilages.

II. 3.—A knee-joint. The synovial membrane, which is thickened, has been injected to show its great increase of vascularity. It appears villous and flocculent on its internal surface, and has grown over and into the articular cartilages at their margins, from which it can be raised by needles, showing that these structures are superficially eroded.

c. Blending of the synovial membrane with the capsule and surrounding parts. Edematous, fatty, gelatinous, and pulpy condition of the synovial membrane, and still further encroachment of the synovial tufts in the form of red pulpy masses of granulations upon the cartilages.

II. 24.—A knee-joint. The capsule has been extensively opened, and raised for exposing the cavity of the joint.

The internal surface of the synovial membrane is granulated. The membrane has everywhere become very thick, and especially so at the upper and front part of the joint, where its thickness is not less than two inches. The part of the membrane opposed to the articular cartilage of the femur was adherent to it. The whole of the soft parts exterior to the joint have been carefully removed.

II. 41.—Portion of a synovial membrane, with the patella, from the knee-joint, seen in II. 40. The synovial membrane is considerably thickened, its internal surface is granulated, and portions of it, in pulpy irregular masses, overlay, so as to nearly conceal the cartilaginous surface of the patella.

Changes in the cartilages.

a. Loss of translucency; erosion and perforation of the cartilages by fungous granulations from the synovial tufts.

II. 3.—A knee-joint. The cartilages are superficially eroded by the overgrowing synovial tufts. See also II. 41.

b. Complete destruction of the cartilages by the fungating granulations.

II. 5.—An ankle-joint. The cartilages are completely destroyed, and the bones are covered by fungating granulations.

The minute changes which occur in the destruction of the cartilage (formerly called ulceration) consist in the proliferation of the cartilage-cells in consequence of the increased nourishment which they receive from the vascular ingrowing synovial tufts; in the blending of the proliferating cartilage-cells with those of the synovial ingrowths, and the consequent softening and liquefaction of the matrix by the combined proliferating mass.

It will be thus seen that the destruction of the cartilage, as pointed out by Billroth, takes place in the same way as the destruction of bone, with the difference, however, that the cartilage-cells themselves take an active part in the destruction of the intercellular substance, while the bone-cells remain inactive, the absorption being effected solely by the exuberance of the cells (inflammatory material), in the Haversian canals.

In some instances the bones become inflamed before the cartilages

have been perforated by the fungating growth from the synovial membrane. In such instances a similar fungating mass of granulations springs from the bone, and invades the deeper layers of the cartilage, so that the cartilages become loosened from the bone and lie partly movable between the upper and lower layer of granulations. (Billroth.)

II. 31.—Bones of a knee-joint, exhibiting the effects of inflammation. Parts of the free surface of the cartilage upon each bone have been destroyed. There has also been a more extensive erosion of the deep or attached surface of the cartilage, so that its connection with the bone was loosened, and it was readily separable from it. Where the absorption of the deep surface of the cartilage has taken place granulations have arisen from the bone.

Changes in the bones.

a. Invasion of the bone by the proliferating granulations derived from the inflamed synovial tufts; inflammation and subsequent ulceration of the bones (strumous caries).

II. 5.—Bones of an ankle-joint. They are covered by fungating synovial tufts, and are in places ulcerated.

The minute changes in the bone are essentially the same as those which occur in acute synovitis running on to destruction of the joint, viz. rarifying osteitis and caries. The osteitis and subsequent ulceration following strumous synovitis, however, appear generally to be induced by the proliferating synovial granulations which invade the bone; there is also greater destruction of the affected bone, and less tendency to ankylosis and the formation of new bone around. The destruction, however, though more extensive than after acute synovitis, is less extensive than when the inflammation begins in the bones themselves.

b. Dislocation of the ulcerated articular surfaces of the affected bones.

II. 17.—A hip-joint, from an adult, exhibiting the effects of inflammation. The head of the femur is dislocated from the acetabulum, and is drawn upwards and backwards upon the dorsum of the ilium, where it rests surrounded by a capsule formed, probably, in part by the diseased old capsule, and in part by the surrounding tissue thickened and consolidated.

c. Ankylosis of the bones entering into the formation of the affected joint.

Sub-series B. 26.—The bones of a knee-joint, light, spongy, and partially ulcerated. What remains of the patella is united by bone to the femur, and the condyles of the femur are similarly ankylosed to the head of the tibia. See also Sub-series B. 4.

Such a favorable termination as ankylosis is much less common after strumous disease than after destructive inflammation of the joint consequent upon acute synovitis.

d. Atrophy and fatty degeneration of the affected bones from prolonged rest and faulty nutrition.

I. 56.—Section of the bones of a diseased elbow-joint, from a boy in whom the disease had lasted three years. Their whole texture is very light and brittle.

Sub-series B. 45.—Pelvis and femora, from a young man. The head of the femur and the acetabulum on the left side exhibit changes consequent on long-continued disease of the hip-joint. The left os innominatum and femur, atrophied, probably in consequence of their disuse, are considerably thinner and smaller in all their dimensions than the bones of the opposite side, and the left side of the pelvis is contracted by the nearly vertical position of the ilium.

STRUMOUS DISEASE BEGINNING IN THE BONES—ARTICULAR CARIES.

When the disease has its origin in the bones it begins as a chronic inflammation (strumous caries) of their articular ends. The fungous granulations (inflammatory material) filling the carious bone gradually make their way into the joint, loosening, eroding, or perforating the cartilages, and setting up inflammation in the synovial membrane. After the synovial membrane has become involved rapid disorganization of the joint ensues, accompanied by similar phenomena to those already described. The destruction of the bones, however, is more extensive, and the disorganization of the joint consequently more complete.

Changes in the bones.

The changes which occur in the bones previously to the joint becoming involved will be found described in detail under Caries, p. 17, and Struma in Bone, p. 41. The following specimens may also be studied as further illustrations of these changes.

II. 35.—Portion of a femur, from a young subject. Disease commencing in the hip-joint, has in its progress occasioned a separation of the head of the femur in the line in which, as an epiphysis, it was connected with the neck. There is also ulceration of a part of the surface of the head and neck of the bone.

II. 48.—Bones of the hip-joint, from a boy eighteen years old. Part of the head and neck of the femur has been removed by ulceration. There has been also ulceration of the wall of the acetabulum, widening its cavity, and at one point penetrating into the pelvis. New bone has been formed in the bottom of the acetabulum, and was intimately united with the rough ulcerated surface of the femur.

II. 49.—A hip-joint, from a boy ten years old. The head of the femur has been dislocated from the acetabulum to the dorsum of the ilium. Ulceration of the capsule had taken place, and the head of the bone was contained in a cavity formed by the remains of the capsule and by the surrounding muscles. Within this cavity, as well as in the acetabulum, was a mixture of a large quantity of pus and tuberculous matter. The section of the head of the femur shows tuberculous matter deposited in its cancellous texture. There is also a collection of tuberculous matter in the walls of the acetabulum communicating with its cavity and with the cavity of the pelvis. An abscess had formed between the periosteum and the shaft of the bone just below the trochanter. The ischiatic nerve is seen upon the tuberosity of the ischium, near the dislocated head of the bone.

II. 16.—Portion of a child's femur, of which the greater part of the head has been destroyed by ulceration. A portion of the head remains, but it is completely detached and is ulcerated on every surface.

II. 13.—A wrist-joint. The lower ends of a radius and ulna, with the bones of the carpus and metacarpus, exhibiting extensive disease in or about the carpus, with necrosis of the lower end of the radius. A considerable portion of the end of the radius, already deeply ulcerated, died and was in process of exfoliation. The cartilage between the ulna and the bones of the carpus is completely destroyed. The ulna and the bones of the carpus have their cartilaginous surfaces destroyed by ulceration, and ankylosis has taken place between them, both by adhesion of their surface and by thickening and consolidation of the surrounding parts.

II. 18.—A hip-joint, from a child, in which, by a further progress of the inflammation shown in the preceding specimens, both the acetabulum and the whole of the head and neck of the femur have been destroyed by ulceration.

Changes in the cartilages.

Invasion of the cartilages by the fungous granulations (inflammatory material) springing from the surface of the inflamed and ulcerating bone.

II. 37.—Section of a femur, exhibiting the effects of inflammation of the cancellous texture and articular surface of one of its condyles. The increased vascularity of the bone is evinced by the degree in which its vessels have received injection. The connection of the articular cartilage with the bone was loosened, so that it was readily separated.

II. 6.—Sections of the condyles of a femur. The articular cartilage is thinned, and its connection with the bone is so loosened that its separation was readily effected. Portions of the cartilage have been detached and turned downwards, to show that parts of the surface which was connected with the bone are unnaturally rough. The exposed surface of bone is very superficially ulcerated and thinly covered by granulations.

II 19.—A hip-joint. The articular cartilages are completely destroyed.

SACRO-ILIAC DISEASE.

Sacro-iliac disease is rare; it appears to be of the nature of strumous inflammation. It has been attributed to injury received during parturition, but its origin is generally obscure. Three specimens follow.

Sub-series B. 54.—Portions of an os innominatum and a sacrum, exhibiting the effects of inflammation in the sacro-iliac symphysis and the posterior part of the ilium. The surface of the diseased bone is ulcerated, and around it are irregular deposits of new bone. A large circular hole is seen in the ilium, the result of necrosis of a portion of its texture.

Sub-series B. 55.—An os innominatum and a sacrum united by a bridge of bone, an inch wide, extending across the front of the right sacro-iliac symphysis. The symphysis itself appears to have been healthy.

Sub-series B. 56.—A similar specimen, but the bridge of bone is much wider, extending from the upper edge of the sacrum to the margin of the superior aperture of the pelvis.

CHRONIC RHEUMATIC ARTHRITIS.

Chronic rheumatic arthritis, also called dry chronic rheumatic arthritis, *malum coxæ senilis*, *arthritis deformans*, &c., is characterised by the fibroid changes which occur in the cartilages; by the smooth, polished, porcellaneous appearance of the articular surfaces of the bones; by the pedunculated processes which project from the inner surface of the synovial membrane; by the formation of flat nodular osteophytes around the affected joint; and by the absence of suppuration. It commonly occurs in old age, and may attack any of the joints, but is most frequent in the hip and shoulder.

There is some doubt as to which tissue of the joint is primarily affected, as opportunities for examining the disease in an early stage seldom occur. By some it is believed to begin as a chronic inflammation of the synovial membrane; by others as a fibroid degeneration of the cartilages; by others, again, as an inflammation in the ligaments. In whichever way it begins the synovial membrane, which at first is said to be preternaturally dry, becomes slightly thickened and vascular, and moderately distended with thin, cloudy, synovial fluid; whilst its fringes become hypertrophied and assume

the form of pedunculated processes, often containing little masses of cartilage or bone, very characteristic of the disease. The cartilages undergo fibroid degeneration and are gradually destroyed. The articular surfaces of the bones become excessively smooth, hard, polished, and porcellaneous, from the friction of the articular surfaces upon each other in the movement of the joint; characteristic flattened, nodular osteophytes form around the articular surfaces of the bones and in the soft structures in connection with the joint, rendering the articulation in severe cases completely useless. These changes may be studied in detail by aid of preparations.

Changes in the cartilages.

Nodular and cracked, and subsequently rough and fibrous appearance of the cartilages.

II. 51.—A patella, exhibiting fibroid degeneration of the articular cartilage. The disease affects only half the cartilage. At the borders of the diseased part there are cracks extending in various directions through the whole thickness of the cartilage, and some of its substance between the cracks is converted into close-set tufts of fine filaments, which float out from the surface of the bone, and are about twice as long as the healthy cartilage is thick. In the centre of the diseased spot, where the morbid change has made most progress, the cartilage has been wholly removed, and the exposed surface of the patella is hard and nodulated.

II. 52.—The bones of two hip-joints from the same person. In each joint are exhibited the same morbid changes. Nothing remains of either ligamentum teres except a few shreds of fibrous tissue attached to the head of each femur. Close by the insertion of this ligament a similar small portion of each of the articular cartilages has been removed, and on the anterior surface of the neck of each femur there is an irregular aperture in its synovial and fibrous covering, beneath which the surface of the bone is hard and nodulated.

II. 53.—The bones and ligaments of a knee-joint. The anterior crucial ligament is wanting, and small portions of the articular cartilages of the femur and tibia have been destroyed after fibrous degeneration. The opposite joint was similarly and symmetrically diseased.

The destruction of the ligaments in an apparently early stage of the disease, as seen in the two preceding specimens, has led some to believe that the disease begins in these structures.

The above changes, commonly called fibroid degeneration of cartilage, are due to the splitting up of the matrix into fibres; the multiplication, enlargement, and fatty degeneration of the cartilage-cells; and the gradual rubbing away of the fibrillated cartilage by the friction of the articular surfaces of the joint upon each other.

It will be thus seen that this fibroid destruction differs very materially from the so-called ulceration of the cartilage accompanying inflammatory joint affections, where the matrix, instead of becoming fibrous, undergoes liquefaction and softening.

Changes in the bones.

Exposure of the bones by the complete removal of their articular cartilages; indurated, polished, and porcellaneous condition of their articular surfaces; distortion of their articular ends; and formation of flat nodular masses of new bone (osteophytes) around.

Sub-series B. 12.—Sections of the bones of a hip-joint, in which there has been absorption of the upper part of the head of the femur. The surface of the part thus absorbed, as well as that of the acetabulum with which it was in contact, and on which it probably moved freely, are polished, ivory-like, and worm-eaten in appearance.

Sub-series B. 17.—Part of a femur, exhibiting absorption, hardening, and polishing of the upper and anterior part, with osseous deposit around the margin of its head.

The cause of this ivory-like or porcellaneous appearance of the bone is somewhat doubtful. Some think it due merely to friction and mechanical pressure; others believe that, over and above this, new bone is formed in the deeper layers of the articular ends, while the superficial is being polished and ground down. The numerous perforations usually seen on the polished surfaces are somewhat difficult of explanation; they are most probably enlarged blood spaces. The flattened nodular osteophytes, which constantly form around the articular surfaces, present a marked contrast to the stalactitic formations so common after inflammatory joint affections. The various changes in the sockets and heads of the bones may be studied under the heading of chronic rheumatic arthritis of special joints.

Changes in the synovial membrane.

Thickening and increased vascularity of the synovial membrane; formation of numerous pendulous growths, containing little masses of cartilage, bone, or fat, upon its internal surface; slight increase of synovial fluid; turbidity of the fluid from admixture with particles of disintegrating cartilage.

II. 20.—A hip-joint. All the articular cartilage is removed, and the surfaces of the bones are smooth, hard, and polished. The synovial membrane is thickened, and upon its internal surface around the neck of the femur there are several groups of slender pendulous growths.

II. 22.—A shoulder-joint, in which there has been degeneration and removal of the articular cartilage, with hardening of the adjacent bone

The synovial membrane is generally thickened, and there are numerous groups of small pendulous processes of cartilage, and two larger masses of hard, nodulated bone attached to its internal surface.

II. 28.—A knee-joint, exhibiting numerous growths on its internal surface. The growths are of various sizes, nodulated, grouped, and attached, for the most part, by narrow pedicles. They are most abundant about the margins of the articular surfaces of the bones, that is, in the synovial fringes; some of them are cartilaginous, others osseous; and there are some of them which consist of fat. The heads of the bones are enlarged, their articular cartilages are removed, and their exposed surfaces are hard and polished. There were four ounces of fluid, like train oil, in the cavity of the joint. The disease had existed for more than two years.

These pendulous growths are the hypertrophied synovial tufts; the masses of cartilage are produced by the over-development of the cartilage-cells which the tufts normally contain. The little masses of cartilage sometimes become detached by the absorption or breaking of their peduncles, and are then found loose in the joint.

Changes in the tissues around the joint.

Formation of nodular flattened osteophytes in the ligaments, periosteum, tendons, and even in the muscles around the joint.

Sub-series B. 58.—The bones forming a knee-joint. Their surfaces are irregular and rough, from an abundant formation of compact new bone. Other portions of bone were scattered amidst the thickened tissues which surrounded the articulation, and which had amalgamated into a coarse fibrous structure.

The changes had been preceded by chronic rheumatic arthritis.

CHRONIC RHEUMATIC ARTHRITIS IN DIFFERENT JOINTS.

The characteristic appearances of chronic rheumatic arthritis, dependent upon the movement peculiar to the respective joints, should next be studied.

The hip-joint.

The characteristic appearances in the hip-joint consist in—

Flattening and widening of the head of the femur with absorption of its neck; deepening or widening of the acetabulum; destruction of ligamentum teres.

The absorption of the neck of the femur has been mistaken for bony union following intra-capsular fracture.

It may generally be distinguished from fracture by the porcel-

laneous appearance of the articular surface of the head, the abundant nodular osteophytes around, and by the absence of any marked line of union, such as is commonly present after fracture.

The shortening of the limb which is so often found in aged people after falls, and which has been ascribed to intra-capsular fracture, is more probably due in many cases to the absorption of the neck of the bone, the result of chronic rheumatic arthritis which has escaped notice previous to the accident.

Sub-series B. 20.—Portion of a femur, in which the articular part of the head has been absorbed, flattened, and increased in width. Part of the surface absorbed is hard, polished, and perforated; new bone is formed on other parts.

Sub-series B. 9.—The bones of a hip-joint, exhibiting absorption of the acetabulum and of the head and neck of the femur. Osseous deposit has taken place around the neck of the femur, and in thick nodules upon the posterior and inferior margins of the acetabulum. The remains of the head of the femur were adapted to the surface of new bone formed on the acetabulum; and the summit of a very large mass of new bone growing up from the upper part of the neck rested on the surface of the new bone formed behind the posterior margin of the acetabulum. See also Sub-series B. 7.

Sub-series B. 11.—Sections of the bones of a hip-joint, in which portions of the articular surfaces of the acetabulum and of the head of the femur have become finely polished and of an ivory-like texture. The polished portions are deeply penetrated by numerous minute irregular canals; and there is abundant formation of new bone round the margin of the head and on the neck of the femur, as well as about the brim of the acetabulum.

Sub-series B. 12.—A similar specimen.

Sub-series B. 16.—Sections of the bones of a hip-joint, in which the depth of the acetabulum is increased by the deposit of osseous matter around its margin. Its articular surface, and that of the head of the femur, have been absorbed, and the surfaces exposed are hard, perforated, and in a few parts polished. A formation of new bone round the margin of the head of the femur corresponds with that on the margin of the acetabulum.

Compare these specimens with those of ulceration, following acute synovitis and chronic inflammation. Sub-series B. 18, 33, &c.

The shoulder-joint.

The characteristic appearances in the shoulder are—

Flattening and enlargement of the articular surface of the head of the humerus; enlargement and deepening of the glenoid cavity; destruction or displacement of the biceps tendon.

Chronic rheumatic disease of the shoulder-joint has been mistaken for old dislocation of the shoulder; it may generally be dis-

tinguished from the latter by the osteophytes around, and by the polished appearance of the articular surface.

Sub-series B. 32.—The bones of both the shoulder-joints of an adult. In each joint there has been ulceration, or such absorption as occurs in chronic rheumatism, of the articular surfaces of the head of the humerus and glenoid cavity. The heads of the humeri are flattened and enlarged by growths of bone around their borders; and the glenoid cavities, enlarged in a corresponding degree and deepened, extend backwards and inwards to the bases of the spines of the scapulæ. The articular surfaces thus enlarged are mutually adapted, and are hardened, perforated, and in some parts polished and ivory-like. The changes of structure are symmetrical, except in that the articular surfaces of the right shoulder-joint are more extensively polished than those of the left.

Sub-series B. 44.—A humerus and a scapula. There is a deposit of bone upon the end of the acromion, presenting an excavation on its under surface. The great tuberosity of the humerus presents a convex surface, which appears to have been adapted to, and to have moved in, the concavity on the under part of the acromion.

It is probable that these changes followed the destruction of the tendon of the biceps muscle, either by disease or by accidental rupture.

Sub-series B. 52.—A scapula and the upper part of a humerus diseased in the same manner as B. 44. The borders of the acromion are thickened and beset by nodules of new bone. A small portion of its inferior surface, indurated and polished, was adapted to a similar surface on the upper part of the head and the great tubercle of the humerus. Around the head of the humerus and on its tuberosities there are deposits of bone similar to those on the borders of the acromion.

The knee-joint.

The characteristic appearances in the knee-joint are—

Inclination of the femur and tibia inwards; displacement of the patella outwards, so that it rests upon the outer condyle of the femur; vertical grooving of the patella and corresponding surface of the condyle of the femur; destruction of the crucial ligaments.

Sub-series B. 47.—Bones of two knee-joints. There has been a deposit of new bone around the articular surfaces of both the femur and the patella. The patellæ, displaced outwards, have been adapted to the outer condyles; and their articular cartilages having been completely removed, the opposite surfaces of the bone have been absorbed in regular and mutually adapted grooves, and are hardened, polished, and ivory-like. [See also II. 53.]

The elbow-joint.

The characteristic appearance in the elbow-joint are well seen in the following specimen.

Sub-series B. 53.—A humerus, radius, and ulna. In consequence of chronic disease of the elbow-joint, the forearm appears to have been for a long time nearly fixed in a position of extreme flexion, with the hand in extreme pronation. The articular surface of the humerus is much deformed; the internal condyle is reduced in size and pointed; the trochlear cavity is nearly obliterated; the greater part of the articular cartilage was removed; the external condyle has a part of its surface hardened and polished; and nodules of new bone have been deposited around the borders of the articular surface.

The outer division of the greater sigmoid cavity of the ulna is hard, polished, and superficially grooved; the inner division is soft and rough, as if it had been deeply ulcerated. The lesser sigmoid cavity is obliterated; and just below its place, there is a large and deep pit in which the tubercle of the radius rested. The head of the radius is directed backwards from the shaft. The articular surface has lost its cartilage, and new bone is deposited around a great part of its border. The anterior border of the head of the radius, which rested on the front of the external condyle of the humerus, has formed a wide and slightly concave surface, which is covered by hard polished bone, like that on the surface of the condyle itself.

The lower ends of the shafts of the radius and ulna are healthy.

The temporo-maxillary joint.

See. II. 27 and 42, and Sub-series A. 87.

The articular joints of the spine.

II. 71.—A lumbar vertebra with chronic rheumatic disease, more especially of the articular process.

The joints of the great toe.

II. 65.—The bones of the great toes of an old person, showing the effects of chronic rheumatism.

GOUTY ARTHRITIS.

After a patient has suffered from a few attacks of gout, and the disease has become chronic, a characteristic chalky-looking material is deposited in the articular cartilages, ligaments, and synovial membrane of the affected joints, and after some time in the connective tissue around. This chalky material, formerly thought to be carbonate or phosphate of lime, but now known to consist of urate of soda, is deposited in the form of acicular crystals in

the matrix about and around the cartilage capsules and in the interspaces of the connective tissue; it is at first soft, like mortar, but ultimately assumes a hard and chalky appearance. The white masses, so common about the knuckles (chalk stones), are produced in this way. Gouty arthritis, unlike rheumatic arthritis, is principally confined to the smaller joints, and especially attacks the great toe.

II. 10.—An os calcis and astragalus (probably from a gouty person), the articular surfaces of which are uniformly covered by thin deposits of white earthy matter, consisting principally of urate of soda. The cartilages themselves are thin.

II. 11.—A patella, the cartilage of which is similarly whitened by the deposit of earthy matter. It appears also thickened and nodular.

The two preceding specimens were taken from a man between forty and fifty years old. Nearly all the joints in the body were in a similar state; in some a portion of the white substance was in a fluid state, and around some there was a similar deposit in the adjacent tissues.

II. 33.—The articular portions of two femora and two patellæ, from the same individual. A deposit of white earthy matter, the effect of gout, has taken place upon the surface of their articular cartilages.

In some instances gouty arthritis terminates in destruction of the joint, accompanied by ulceration of the articular surfaces of the bones.

II. 38.—The bones of a great toe, in which, in consequence of gout, the articular surfaces of the metatarsal bone and first phalanx are in great part destroyed.

Sub-series B. 35.—The bones of two toes, exhibiting ulceration of their articular surfaces and growths of bone around and near their articular borders, the effects of gout.

ANCHYLOSIS OR STIFF JOINT.

Anchylosis may be divided into the spurious or false, the fibrous or ligamentous, and the bony or true.

SPURIOUS ANCHYLOSIS.

Spurious anchylosis is the term applied to a fixed condition of joint depending upon rigidity of the surrounding muscles, the contraction of cicatrices following burns, the shrinking of the capsule and synovial membrane, from disease of the joint, &c.

II. 7.—A knee-joint, in which anchylosis has been effected by inflammatory thickening of the synovial membrane. A portion of the adherent synovial membrane is reflected from the front of the joint. The tibia and fibula have been drawn backwards and outwards under the femur.

FIBROUS OR LIGAMENTOUS ANCHYLOSIS.

Fibrous or ligamentous ankylosis is the union of the articular surfaces of the bone by fibrous tissue. It may be the result of joint disease, as already described, or of keeping a joint in a long-continued state of rest, in which latter case the synovial fluid is no longer secreted, the synovial membrane loses its smooth polished appearance and becomes dry and fibrous, the cartilages atrophy and disappear, and the bones unite by fibrous tissue.

Fibrous ankylosis, after existing some time, nearly always terminates in osseous ankylosis.

II. 55.—A knee-joint, in which, during the course of long-continued disease, the tibia has been dislocated backwards and outwards. Firm ankylosis by fibrous tissue has taken place between the inner half of the upper surface of the tibia and the condyles of the femur.

BONY ANCHYLOSIS.

Bony ankylosis, as just stated, is a further stage of the fibrous. The articular surfaces may be united evenly and uniformly by bone, by irregular bridges of bone, or partly by bone and partly by fibrous tissue. Union may take place with the articular surfaces in contact with each other, either in a straight position or at different angles, or it may occur with one of the articular surfaces dislocated from the other.

II. 48.—Bones of the hip-joint, from a boy, eighteen years old, in whom disease of the hip had existed twelve years before death. New bone had been formed in the bottom of the acetabulum, and was intimately united with the ulcerated surface of the head of the femur.

Sub-series B. 2.—Section of the bones of a hip-joint, exhibiting complete osseous union of the head of the femur with the acetabulum. Their walls and cancellous tissues have coalesced, and are uninterruptedly continuous. The femur is fixed in extreme flexion.

Sub-series B. 5.—The bones of a hip-joint, in which the head of the femur rests partly on the acetabulum and partly on the ilium, and in this situation has become firmly and smoothly united by bone.

Sub-series B. 8.—The bones of a hip-joint, exhibiting an osseous ankylosis of the head of the femur to the ilium, similar to that shown in the preceding specimen. A thin band of bone, half an inch wide, is extended between the trochanter major and the upper part of the tuberosity of the ischium.

Sub-series B. 22.—The bones of the knee-joint, in which the patella is united by bone to the space between the condyles and femur, and the condyles are similarly united to the articular surfaces of the tibia.

Sub-series B. 50.—A scapula and humerus united by bone. The head of the humerus has disappeared, and the upper part of the shaft is

fixed by an irregular growth of bone to the remains of the glenoid cavity and the base of the coracoid process.

Sub-series B. 29.—The bones of an elbow-joint, in which all the articular surfaces are united and surrounded by bone. The joint is in a half-bent position.

Sub-series B. 30.—Section of the bones of an elbow-joint, in which there is complete osseous ankylosis between the humerus and the ulna.

Sub-series B. 34.—The bones of the carpus, with complete osseous union of their several articular surfaces.

LOOSE BODIES IN JOINTS.

Loose bodies are not unfrequently met with in the larger articulations, especially in the knee. They generally exist singly, but as many as sixty have been found in one joint; in size they vary from that of a millet-seed to that of a chestnut; in structure they are usually cartilaginous or fibro-cartilaginous, occasionally fibrinous or fatty. Specks of bone are frequently found in the cartilaginous bodies. They may be formed in several ways.

1st. By the development of little masses of cartilage in the synovial fringes, and the subsequent detachment of such masses by the absorption or breaking of the narrow bases of the fringes by which they were attached to the synovial membrane.

II. 39.—Portion of an elbow-joint, in which there are several cartilaginous growths from the internal surface of the capsule, immediately above the olecranon. Two of these are closely attached to the capsule. A third is attached to it by a round and thin pedicle, apparently formed by the synovial membrane. One portion of cartilaginous substance, which was found loose in the joint, is at the bottom of the bottle.

II. 34.—Portions of a knee-joint, with various growths upon the internal surface of the synovial membrane. Most of the growths consist of fringes of slender and leaf-like processes of a soft fibrous structure; others are firmer, and approach to cartilage in their character, and one is a flattened, nodulated growth of bone covered by a thin membrane. The other structures of the joint appear healthy. See also II. 22, 25, 26, 66, 74, and 77.

2nd. By "the breaking off or shedding into the cavity of the joint of a portion of proper articular cartilage, together with a layer, more or less substantial, of the adjacent bone" (Marsh).

XXXV. 55.—Two portions of cartilage, removed from the knee-joints of a lad eighteen years old. They are almost exactly alike in form and size, each resembling such a piece of cartilage as might be obtained by removing that which covers the posterior surface of one of the condyles of a femur; and each, as such a piece would be, is smooth and polished on its convex, and rough on its concave, surface.

"The arrangement of the cells in the cartilage in both these

specimens is precisely similar to that of articular or encrusting cartilage" (Marsh).

3rd. By the precipitation or coagulation of the synovia.

No specimen.

4th. By the organisation of a blood clot.

No specimen.

5th. By the organisation of inflammatory exudations from the synovial membrane.

No specimen.

TREATMENT OF JOINT DISEASE BY EXCISION.

Most of the following specimens, which have been selected to illustrate excisions of the joints, merely consist of the excised articular ends of the bones and have already been referred to under "Ulceration." They will, therefore, receive no further description here.

Excision of head of humerus.

II. 60. The upper part of a humerus excised for the remedy of disease in it and in the shoulder joint.

Excision of elbow-joint.

II. 75.—The elbow of a girl, aged twenty. The joint was excised for strumous disease ten months previous to the removal of the limb. The girl came to the hospital seven months afterwards. The arm was useless, the forearm falling when not supported. The fingers were stiff, and their motions all but lost. The thumb could be moved with tolerable precision. The sensation of the inner part of the limb was impaired, and the entire limb was colder than its fellow. It was also manifestly smaller, and was just an inch shorter.

The parts around the joint seemed sound. The cicatrix (H-shaped) was soundly healed, and the limb could be moved in any direction without pain, or any evidence of roughened bone within. After three months' perfect rest on a splint, with great attention to the general health, without improvement, the limb was removed.

The muscles around the joint were firm, of good colour, and not evidently smaller than in health. The biceps and brachialis anticus were natural at their insertion; they had contracted new adhesions. The triceps was adherent to the lowest remaining portion of the humerus, especially on the outer side, and its tendon could be traced on to the ulna. This muscle, unlike its antagonists, was pale and wasted, with much fat between the fasciculi.

The extremities of the bones were surrounded by a tough, firm capsule, most marked anteriorly. The capsule was much strengthened by a thick fibrous cord, extending from the internal condyloid ridge to the coronoid process of the ulna, and the flexor muscles had in part their origin from it.

The ulnar nerve could be traced to the internal condyle, but no further, the nerve there blending with tough, matted, fibrous tissue. An inch above this point there was an appearance, but not a satisfactory one, of a continuation of the nerve.

The capsule, when opened in front and turned back, was found composed of dense fibrous tissue attached to the margins of the divided bones. Its surface in places was smooth and glistening. There was no fluid of any kind within.

The cut surface of the humerus was covered everywhere with fibrous bands passing into the capsule. This was more apparent behind than in front; the cut surface of the radius was covered with some thin, delicate fibres running into the capsule at the margins of the bone. These, when removed, showed the cancellous tissue imperfectly walled in. The surface of the ulna, however, was merely covered with a thin, smooth layer, and, except at the margins, had no attachment to the capsules. Here the extremity of the bone had been covered with a continuous layer of new bone. There were no bands of fibres, which could be traced running from the bones of the forearm to the humerus, other than those of the capsules which enclosed them externally.

See also II. 61 and 62.

Excision of the wrist.

II. 76.—The wrist of a man, aged twenty-eight, from which eight years previously the greater number of the carpal bones were removed on account of strumous disease of the joint. The hand retained very considerable power of flexion and extension until the man's death from phthisis.

With the exception of the trapezium, pisiforme, unciforme, and part of the cuneiforme bones, the carpal bones have been removed. The metacarpal bones have become adapted to the radius and ulna, and united to them by dense fibrous tissue, admitting of some motion at the part. This union has been divided. The remaining bones seem healthy.

Excision of head of femur.

II. 63 and 64. Portions of bone removed in the operation of excision of the head of the femur.

Excision of Knee-joint.

II. 72.—A knee-joint, on which the operation of excision had been performed.

II. 73.—A knee-joint, on which the operation of excision had been performed a considerable time before death. The man was able to walk well with the limb.

II. 78.—Parts removed in an operation for excision of the knee-joint. In flexing the leg whilst opening the articulations the epiphysis of the femur snapped across. The line of separation is seen in the preparation. The specimen also shows the relation of the articular

surfaces modified by the backward displacement of the tibia. The patient, a boy, aged nine, recovered favorably.

II. 85.—A section of the bones of a knee, on which excision had been performed. The femur and the tibia, where they lie in contact with each other, are firmly united by bone. A large sequestrum lies loose in a cavity in the upper end of the tibia. The corresponding section is shown in the next preparation. (II. 86.)

The patient, a lad fourteen years old, and of feeble health, underwent excision of the knee-joint, which was affected with strumous disease of long duration. Many months after the operation the knee remained large, the skin covering it was inflamed and unhealthy, and many sinuses discharged fetid pus. Several operations for the removal of carious and necrosed portions of bone were performed from time to time. The large opening seen at the other side of the joint was made during one of these operations, and through it the sequestrum, which lies at its bottom, was found, and partly gouged away. At length, as the wound did not heal, and as the boy's general health was much reduced, amputation above the knee was performed.

II. 93.—The specimen is one of unsuccessful excision of the knee-joint, from a boy, aged five years. Amputation of the thigh was performed five months after excision. The lower end of the femur considerably overlaps the tibia, and absorption of the bones has occurred where they are in contact. Both soft and hard parts appeared healthy, but there is no formation of callus between the bones.

CHAPTER IV.

INJURIES OF JOINTS.

DISLOCATIONS.

GENERAL PATHOLOGY.

A DISLOCATION has been defined as the removal of the articular surface of a bone from the part with which it is naturally in contact.

VARIETIES.

Dislocations may be divided into :

I. *The congenital*, in which the displacement is the result of some congenital malformation of the articular surfaces of the dislocated bones.

II. *The spontaneous*, in which the displacement is the result of disease.

III. *The accidental*, in which the displacement is the result either of external violence or of sudden excessive muscular action.

The congenital, which is not represented in the museum, and the spontaneous, which will be found treated of under diseases of the joints, will not be further referred to here.

The accidental may be divided into the *Simple*, in which the articular surfaces are merely displaced, and the *Compound*, in which the displacement is accompanied by a wound of the integument communicating with the joint.

SIMPLE DISLOCATIONS.

STATE OF THE PARTS.

The injuries sustained by the joints and surrounding tissues in dislocations may be very extensive or but very slight. Some of the following are generally observed.

The articular surfaces are either partially or completely dis-

placed, the former condition more often occurring in the hinge, the latter in the ball-and-socket joints.

When the displacement is complete, the end of the displaced bone may be found in the situation in which it was driven by the force that produced the displacement, *i. e.* commonly opposite a rent in the capsular ligament through which it was forced; or it may be found occupying a position removed from that in which it was primarily displaced, *i. e.* at some distance from the rent in the capsular ligament, having been drawn into such a secondary situation by the subsequent action of the muscles attached to it.

The ligaments are usually either stretched or torn. The capsular ligament and synovial membrane commonly present a ragged or slit-like aperture at one spot through which the end of the bone has escaped; in partial dislocations, however, the capsule has been found entire.

The *inter-articular cartilages*, when present, are lacerated or displaced.

The muscles are tightly stretched over the joint or torn, and in the living they are generally spasmodically contracted.

The arteries are compressed, or occasionally ruptured.

The nerves are stretched, pressed upon, or torn.

The skin over the joint is frequently stretched; in cases of direct violence often bruised, grazed, or cut.

Blood, moreover, in varying quantities is effused among the above-mentioned tissues.

Dislocations are frequently complicated by fracture of one or more of the bones entering into the affected joint.

III. 68.—A hip-joint, in which dislocation of the femur occurred a week before death. At the back part of the joint a wide laceration of the capsule is seen which was made by the head of the femur in its dislocation from the acetabulum.

III. 20.—A hip-joint, in which a dislocation of the femur, upon the sciatic notch, occurred about three weeks before death. The ligamentum teres has been torn across its middle. An opening in the capsule is seen, but has been partly re-united.

III. 25.—Notice the lacerated ligamentum teres and obturator externus muscle in this specimen.

III. 138.—The left hip-joint, with dislocation of the femur on to the pubes. The tendons of the psoas and the iliacus muscles are stretched over the joint.

III. 56.—Notice the laceration of the obturator internus pyriformis, gemelli and gluteus minimus in this specimen.

III. 100.—In this specimen the sciatic nerve is seen flattened in consequence of altered form of the parts surrounding the dislocated head of the femur.

IMPEDIMENT TO REDUCTION.

In recent cases reduction is impeded by spasmodic contraction of the muscles surrounding the joint, sometimes by the small size of the rent in the capsule, occasionally by the hitching of portions of bone; in old-standing cases by the permanent contraction or shortening of the muscles and ligaments, the formation of adhesions, the healing of the rent in the capsule, or the filling up of the articular cavity with new bone.

III. 20.—A hip-joint, in which dislocation of the femur occurred about three weeks before death. Only a small part of the rent in the capsule, through which the head of the bone escaped, is visible, the larger part of it having already united.

III. 31.—An unreduced dislocation of the head of the femur. The acetabulum is converted into a narrow triangular cavity nearly filled with fibrous tissue. The head of the bone is deformed and reduced in size. See also III. 25, 42, 43, 112, and 118.

STATE OF THE PARTS AFTER REDUCTION.

After reduction the synovial membrane becomes slightly inflamed, with a moderate effusion of serum into the cavity of the joint. If the parts are kept at rest, the rent in the capsule heals, the inflammation subsides in a few days, and the joint is restored to its normal condition. Sometimes, when perfect rest is not maintained, the rent in the capsule does not heal, but its edges become smooth, allowing the head of the bone to slip in and out of its socket.

In rare instances the joint becomes acutely inflamed and suppurates leading to the destruction of the articulation and subsequent ankylosis.

III. 102. A hip-joint, with the head of the femur and part of the acetabulum, from a man who had a dislocation of the femur on the dorsum of the ilium three years before death. The dislocation was soon reduced, and the only traces of its effects which remain are, that there is a strong band or collar of ligamentous tissue around the base of the neck of the femur at its upper part, and that a slip of the ligamentum teres is attached to the notch of the acetabulum external to the cotyloid ligament. But with this exception the ligamentum teres presents no sign of having been torn.

CONSEQUENCES OF NON-REDUCTION.

When a dislocation remains long unreduced, one of two results commonly occurs, the formation of a new joint, or ankylosis; the former condition is most common after dislocations of ball-and-

socket joints where a certain amount of mobility is possible and has been kept up, the latter after dislocation of hinge joints where motion is slight or impossible.

Formation of false joints,

I. *After dislocations of ball-and-socket joints.*—The surface upon which the displaced bone rests becomes shaped into a new articular cavity, partly by absorption of the old bone and partly by the heaping up of new bone around. At the same time the displaced bone becomes adapted by absorption to its new socket, and the soft tissues around become condensed and converted into fibrous tissue forming a kind of new capsule. The ends of the bone appear either smooth, polished, and porcellaneous, or covered with fibrous tissue, and in some instances with fibro-cartilage. The old socket becomes filled up with fibrous tissue which usually ossifies. In some instances the new cavity encroaches upon and partially causes the absorption of the old.

III. 112.—A right shoulder-joint, exhibiting an unreduced dislocation of the humerus of long standing. The head of the humerus, with a great part of its cartilage removed, and its articular surface hardened, rests on the anterior surface of the scapula with a thick layer of fibrous tissue intervening between it and the bone. The glenoid cavity retains its natural form, but its articular cartilage is thin and has numerous shreds, apparently of fibrous tissue, upon it.

III. 1.—A shoulder joint. The surfaces of the scapula and humerus, brought into contact, by absorption are exactly adapted to each other, and are covered by a substance like cartilage, so as to form a new joint.

It is probable that these changes were the result of dislocation of the humerus.

III. 118.—A shoulder-joint, in which a dislocation occurred long before death and was not reduced. Tough ligamentous tissue has been formed on the scapula, beneath the head of the humerus, and a new fibrous capsule surrounded it. The surface of the glenoid cavity is covered by similar fibrous tissue, and that part of the head of the humerus which was in contact with its anterior margin has been absorbed.

III. 100.—Section of the head and neck of a femur, with the os innominatum of a man in whom dislocation of the femur and fracture of the acetabulum occurred fifty years before death. The dislocation was reduced; but, soon after, the head of the bone again escaped from the acetabulum, and was not again reduced. The head and neck of the femur are altered in form; shortened, flattened, and much increased in their vertical diameter; and the cancellous tissue of a thick layer of the head of the femur is consolidated and hard. A new and deep osseous cavity, with very thick walls, extends from the os innominatum, as if growing out from the acetabulum, and encloses the head and part of the

neck of the femur. The wall of bone, by which this cavity is separated from that of the pelvis, and which includes the former floor of the acetabulum, is an inch and a quarter in thickness, and is chiefly formed, like the rest of the walls of the cavity, of hard compact new bone. The surface of the cavity, and that of the head of the femur, are covered and partly connected by fibrous tissue; they have no articular cartilage.

III. 31.—A hip-joint. On one side of the preparation is a part of the original capsule. On the other side is the head of the bone surrounded by a thick membrane of fibrous tissue. This membrane forming the capsule of the new joint, is in part newly formed, and in part consists of the remains of the former capsule; it is extensively divided behind, to give a distinct view of the head of the bone. The cavity of the new capsule communicates with that of the old capsule below the neck of the femur, and their smooth internal linings are continuous.

Sub-series C. 27.—A scapula and humerus. A concave surface has been formed upon the anterior surface of the scapula, upon which the humerus rested. The pressure of the posterior part of the head of the humerus against the anterior margin of the glenoid cavity has caused them both to be partially absorbed; and the remaining edge of the glenoid cavity, fitting in the recess in the head of the humerus, forms a kind of new joint between them. See also Sub-series C. 34.

Sub-series C. 79.—A humerus and scapula. A hollow and partly polished surface has been formed upon the scapula in adaptation to the head of the humerus. The neck of the humerus moving upon and across the inferior half of the glenoid cavity and the adjacent part of the lower border of the scapula, their opposite surfaces are here accurately adapted and highly polished; the surface of the scapula is at this part become broad and convex, while that of the humerus is deeply hollowed out. The lower part of the glenoid cavity has disappeared, being comprised in the new joint formed with the neck of the humerus.

Sub-series C. 103.—A scapula and humerus in which there has been a dislocation of the head of the humerus, &c. The head of the bone was found resting against the anterior border and concave surface of the scapula close to the glenoid cavity and below the coracoid process. A deposit of osseous substance, forming a hollow articular surface, has taken place upon the scapula in this situation.

II. *After dislocation of hinge joints.*—Although ankylosis is the more common result, a false joint may nevertheless be formed if a certain amount of mobility is kept up. The false joint, however, will be of the hinge variety, the bones merely becoming grooved and adapted to one another, in part by absorption in consequence of mutual pressure, in part by heaping up of new bone around.

III. 33.—An elbow-joint, exhibiting an unreduced dislocation of the radius and ulna backwards. The articular surface of the humerus was

completely covered by a newly formed capsule, the cavity of which is laid open from the front. The head of the radius and articular surface of the ulna are also enclosed in new capsules separated from each other, and from that which encloses the articular surface of the humerus. The sigmoid cavity of the ulna appears to rest on a prominence of bone extending from the posterior surface of the trochlea of the humerus. The head of the radius is confined in the place which it now occupies by a thick fibrous cord extending from its upper surface to a process of bone connected with the margin of the humerus, just above the outer condyle.

Sub-series C. 77.—The bones of an elbow-joint, exhibiting the effects of unreduced dislocation. The head of the radius, misshapen, elongated and flattened, appears to have rested upon and moved obliquely across the front and outer part of the lower end of the shaft of the humerus. A cavity is here formed on the humerus to which the head of the radius fits.

Anchylosis.

When the dislocated parts remain immoveably fixed upon each other, their articular cartilages become absorbed, and their place occupied by cicatricial fibrous tissue, which afterwards undergoes ossification. Such a result, as before stated, is more common after dislocations of hinge joints, than after those of ball-and-socket joints.

III. 57.—The bones of a great toe. The second phalanx dislocated upon the upper surface of the first phalanx, has there become firmly fixed by bone.

III. 13.—An elbow-joint, in which the head of the radius was dislocated backwards. No reduction of the dislocated bone having been effected, it has become extensively united to the side of the ulna.

COMPOUND DISLOCATIONS.

A compound dislocation is one in which the displacement of the bones is complicated by an external wound communicating with the affected joint. In some instances the end of one of the displaced bones protrudes through the wound. If the wound is small and has been early closed, the joint may be restored to its normal condition; if, however, the wound is large, and accompanied with much laceration and bruising of the soft tissues, suppuration may ensue and anchylosis probably result.

There is no specimen in the Museum.

SPECIAL DISLOCATIONS.

Only those dislocations are described that are illustrated by specimens in the Museum.

DISLOCATIONS OF UPPER EXTREMITY.

DISLOCATION OF THE CLAVICLE.

Dislocation of the clavicle is rare, whereas fracture of this bone, as we have seen, is especially common. Either end may be dislocated; the only specimen in the Museum is one of dislocation of the sternal end forwards and downwards. The sternal end may also be displaced backwards or upwards, but these two latter displacements are rare. The scapular end may be displaced upwards or downwards.

III. 97.—Portion of a clavicle with the upper piece of the sternum and first rib. The sternal end of the clavicle is dislocated downwards and forwards. The capsule belonging to its articulation with the sternum is torn; but the costo-clavicular ligament is entire. The first rib is separated from its cartilage.

DISLOCATION OF THE HUMERUS.

Dislocation of the humerus is very common. The head of the bone may be displaced in the following directions:

1. Forwards and inwards upon the anterior surface of the glenoid cavity (subcoracoid).
2. Downwards and slightly inwards on to the anterior costa of the scapula (subglenoid).
3. Backwards and downwards into the infra-spinous fossa (subspinous).
4. Forwards and inwards beneath the clavicle (subclavicular).

A displacement of the bone upwards (subacromial), which has been described as a form of dislocation, is more generally believed to be the result of chronic rheumatic arthritis.

Other varieties of dislocation of the humerus have also been described, but they are merely slight modifications of those above enumerated.

I. *Subcoracoid.*

The head of the bone is displaced forwards and inwards upon the anterior surface of the glenoid cavity, just below the coracoid process, the groove between the head and greater tuberosity resting on the anterior margin of the glenoid cavity (Flower). The subscapu-

laris muscle is generally raised by the head of the bone from the subscapular fossa, and the supra-spinatus, infra-spinatus, and teres minor are either tightly stretched or torn completely across at their insertion into the greater tuberosity; or the greater tuberosity may be separated with the above-mentioned muscles, which themselves remain entire. When the muscles are completely torn, or the tuberosity is detached, the head of the bone will be displaced further inwards than when these conditions are not present.

The long head of the biceps is generally uninjured, whilst the short head, together with the coraco-brachialis, axillary artery and brachial plexus, are displaced slightly inwards and more or less pressed upon by the head of the bone. The circumflex nerve from its situation is frequently subjected to severe pressure, causing temporary paralysis of the deltoid.

III. 47.—A shoulder-joint with the shaft of the humerus, exhibiting dislocation and fracture. The head of the humerus is thrown forwards beneath the coracoid process. The tendon of the long head of the biceps is entire. The tendons of the supra-spinatus, infra-spinatus, teres minor, and subscapularis muscles are also entire.

III. 112.—A right shoulder-joint exhibiting an unreduced dislocation of the humerus of long standing. The head of the bone is directly below, and nearly in contact with the coracoid process, just on the inner side of the glenoid cavity, but not below its level; the axillary artery and plexus of nerves are close to it on its anterior and inner aspect. The infra-spinatus, teres minor, and sub-scapularis muscles are shown retaining their natural connections with the head of the humerus.

III. 118.—A shoulder-joint, in which a dislocation of the humerus occurred long before death, and was not reduced. The head of the humerus rested on the anterior margin of the glenoid cavity, just below the coracoid process. The tendons of the biceps, supra-spinatus, infra-spinatus, teres minor, and subscapularis, muscles are all shown retaining their proper attachments.

Sub-series C. 27.—A scapula and humerus. The head of the humerus appears to have been dislocated forwards, and to have remained long unreduced just beneath the coracoid process, on the anterior surface and neck of the scapula, where a new joint has been formed.

Sub-series C. 103.—A scapula and humerus, in which there has been a subcoracoid dislocation of the head of the humerus with a fracture of the neck.

The *subcoracoid* and *intracoracoid* dislocations of Malgaigne are merely varieties of the subcoracoid as here defined. In the former the head of the bone is directly under the coracoid process, in the latter a little internal to it; in the former the posterior scapular muscles are generally entire and on the stretch; in the latter torn or detached along with the tuberosity.

II. *Subglenoid.*

The head of the bone is displaced downwards and slightly inwards on to the inferior border of the scapula, a little below and internal to the glenoid cavity. The capsular ligament is always ruptured at its lowest part. The supra-spinatus, infra-spinatus, teres minor, and subscapularis may or may not be torn. The circumflex nerve is, especially in this variety, pressed upon by the displaced head.

III. 42.—A shoulder-joint, exhibiting dislocation of the humerus which occurred eighteen months before death. The head of the humerus rests on the anterior surface, near the inferior border, of the scapula. The tendons of the supra-spinatus, infra-spinatus, teres minor and sub-scapularis muscle are entire. A bristle is passed beneath the tendon of the sub-scapularis, close to its insertion. A bristle is also passed beneath the tendon of the long head of the biceps, which retains its attachment to the edge of the glenoid cavity. Two bristles are placed beneath the circumflex nerve, which has been compressed by the dislocated head of the humerus and is, in consequence, flattened and firmly adherent to the capsule of the joint. The dislocation was followed by permanent paralysis of the deltoid muscle.

III. *Subspinous.*

The head of the bone is displaced on to the posterior margin of the glenoid cavity, on to the back of the neck of the scapula, or on to the infra-spinous fossa beneath the spine (Flower). The infra-spinatus is generally torn up by the head of the bone, and the sub-scapularis either stretched or ruptured, according to the amount of displacement. The capsular ligament may or may not be torn, and the tendon of the biceps may or may not be displaced from its groove.

1st. *Variety. Head resting on posterior margin of glenoid cavity.*—III. 53.—Shoulder-joint, exhibiting an incomplete dislocation of the humerus backwards. The head of the humerus, unaltered in form, rests against the posterior border of the glenoid cavity. The tendons of the supra-spinatus and infra-spinatus are detached from the tuberosity of the humerus, but retain their connection with the capsule. The tendon of the biceps is displaced from its groove in the humerus, and retains its attachment to the glenoid cavity. The tendons of the teres minor and subscapularis retain their attachments to the humerus. The capsule of the joint is thickened.

2nd *Variety. Head resting on the back of the neck of the scapula.*—Sub-series C. 79. A humerus and scapula, exhibiting dislocation which occurred a considerable time before death. The head of the humerus was displaced upwards and backwards upon the back of the neck of the scapula. Its anterior margin rested against the inferior surface

and the outer edge of the spine of the scapula, in which situation a hollow and partly polished surface has been formed in adaptation to it. The lower part of the glenoid cavity has disappeared, being comprised in the new joint formed with the neck of the humerus. A cast of this shoulder, before the removal of the soft part, No. 76.

3rd Variety. Head resting on infra-spinous fossa.—No specimen in the Museum.

IV. *Subclavicular.*

Very rare. The head of the bone is displaced forwards and inwards beneath the clavicle to the inner side of the coracoid process, under the pectoral muscles, resting upon or between the fibres of the subscapularis. The supra-spinatus and infra-spinatus are generally torn through or detached from the humerus, but may retain their connection to the capsule. The teres minor and subscapularis generally retain their connection to the humerus, but the latter muscle is generally torn up from its origin from the subscapular fossa by the head of the bone. The capsule is generally extensively lacerated, the laceration occurring at its inner side.

III. 55. A shoulder-joint, in which a complete dislocation of the humerus occurred about a fortnight before death. The head of the humerus was found resting on the subscapular fossa and immediately below the clavicle. The tendon of the biceps retains its attachments to the margin of the glenoid cavity. The tendons of the supra-spinatus and infra-spinatus are detached from the humerus, but retain their connection with the capsule. The tendons of the teres minor and subscapularis retain their attachment to the humerus. There is a large lacerated aperture in the capsule.

DISLOCATIONS OF THE RADIUS AND ULNA AT THE ELBOW-JOINT.

The following dislocations of the radius and ulna are commonly described :

Both bones : backwards, forwards, inwards, outwards, backwards and inwards, backwards and outwards, or the radius forwards and the ulna backwards.

The radius alone : backwards, forwards, or outwards.

The ulna alone : backwards.

The above dislocations may be complicated by fracture of the olecranon, coronoid process, or condyles of the humerus. Only those illustrated by specimens in the Museum will receive further notice.

Radius and ulna backwards.

III. 33.—Elbow-joint, exhibiting dislocation of the radius and ulna backwards.

Radius backwards.

III. 13.—An elbow-joint in which the head of the radius was dislocated backwards. No reduction of the dislocated bone having been effected, it has become extensively united to the side of the ulna. There appears also to have been a fracture of the internal condyle. All the bones are atrophied.

Radius forwards.

Sub-series C. 37.—The bones of an elbow-joint. A fracture extends in two directions through the internal condyle of the humerus into the elbow-joint. The two portions of the condyle separated by the fracture have not been reunited by bone. The radius was found dislocated forwards in front of the ulna.

Sub-series C. 77.—The bones of an elbow-joint, exhibiting the effects of dislocation and fracture which occurred many years before death and which were followed by long-continued inflammation of the bones. The head of the radius has been dislocated forwards. The shaft of the ulna has been broken a little below the olecranon. The head of the radius, misshapen, elongated, and flattened, appears to have rested and moved obliquely across the front and outer part of the lower end of the shaft of the humerus.

DISLOCATIONS OF THE HAND AT THE WRIST-JOINT.

Dislocation of the hand from the radius and ulna is very rare; fracture of the lower end of the radius was formerly mistaken for it.

The hand may be displaced either backwards or forwards; the latter displacement is extremely rare.

III. 39.—A wrist-joint exhibiting dislocation of the hand forwards. The radius is arched with a convexity directly backwards, near its lower end, but there is no appearance of its having been fractured.

DISLOCATIONS OF THE LOWER EXTREMITY.

DISLOCATIONS OF THE FEMUR AT THE HIP-JOINT.

Dislocations of the femur may be divided into the regular and irregular. In the regular the head of the femur may be displaced in the following directions:

I. Backwards and upwards upon the dorsum of the ilium (dorsal, Bigelow).

II. Backwards into the ischiatic notch (dorsal below the tendon, Bigelow).

III. Downwards and forwards into the foramen ovale (thyroid and downwards, Bigelow).

IV. Forwards upon the pubes (pubic and subspinous, Bigelow).
In the irregular dislocations, the bone may be displaced—

I. Upwards, below the anterior superior spine of the ilium.

II. Downwards and backwards into the lesser ischiatic notch (Wormald's dislocation).

III. Downwards and backwards upon the ischium close to its spine.

IV. Downwards and inwards towards the perineum.

Several other irregular dislocations are described, for which the student is referred to the larger works on surgery.

I. *The regular dislocations.*

Backwards and upwards upon the dorsum of the ilium.

In this, the most common form of dislocation of the femur, the head of the bone is thrown upwards and backwards on to the dorsum of the ilium, the articular surface of the head looking backwards and the great trochanter forwards. The capsular ligament is generally found ruptured behind or below and the round ligament torn, but the ilio-femoral or Y-ligament uninjured. The glutei muscles are raised up from the ilium by the head of the bone, which, according to Bigelow, is always found above the tendon of the obturator internus. Should the external branch of the Y-ligament, which, according to Bigelow, prevents eversion by the external rotator muscles, be ruptured, the femur will be rotated outwards, so that the head of the bone will look forwards, and the trochanter backwards (everted dorsal of Bigelow).

III. 31.—A hip-joint, exhibiting dislocation of the head of the femur on the dorsum of the ilium, which occurred a considerable time before death.

III. 100.—An unreduced dislocation of the femur upon the dorsum of the ilium. The obturator internus muscle is seen below the head of the bone.

Backwards into the ischiatic notch.

The head of the bone is displaced backwards upon the surface of the ilium in front of the ischiatic notch, but is never, according to Bigelow, actually in the notch. A case is described by Professor Pirrie, however, in which, on dissection, the head of the bone was found resting on the pyriformis, *i. e.* in the notch. The articular surface of the head looks backwards, the great trochanter forwards, eversion being prevented by the outer branch of the Y-ligament. The tendon of the obturator internus is described by Bigelow as winding over the neck of the bone, and is believed by him to be the

great obstacle to reduction by extension. The head of the bone is covered by the gluteus maximus, and the capsular and round ligaments are torn. This form of dislocation is believed by Bigelow to be nearly always secondary. He maintains that the head of the bone primarily escapes through a rent in the lower part of the capsule into the thyroid foramen below the tendon of the obturator internus, and is afterwards drawn upwards and backwards towards the ischiatic notch, the tendon of the obturator internus always remaining above the neck of the bone. In the following specimen, however, the rent in the capsule is posterior, so making it probable that the displacement upon the ischiatic notch in this instance was primary.

III. 20.—A hip-joint, in which a dislocation of the head of the femur upon the ischiatic notch occurred about three or four weeks before death. The ligamentum teres has been torn across its middle; no union of it has taken place. The opening in the capsule through which the head of the bone escaped was situated at the posterior part of the joint.

Downwards and forwards into the foramen ovale.

The head is displaced downwards and forwards upon the obturator externus muscle. The head of the bone looks inwards, the trochanter major outwards; the capsular and round ligaments are ruptured, the former at its lower part; the Y-ligament is entire; the glutei, pyriformis, psoas, and iliacus are stretched; the obturator externus is often torn.

III. 25.—A hip-joint, exhibiting a recent dislocation of the head of the femur on the lower edge of the obturator externus muscle. The ligamentum teres is torn from its attachment to the head of the femur. The capsule is extensively lacerated at the inner side and lower part of the joint. The obturator externus muscle is lacerated where the femur rests partly on it and partly on the subjacent obturator ligament.

Forwards upon the pubes.

The head of the bone rests below Poupart's ligament, either upon the pubes or upon the pectineal eminence, near the anterior inferior spine of the ilium. The head looks forwards and the trochanter major backwards. The capsular, and generally the round ligaments are ruptured; the Y-ligament is entire, and produces the eversion of the limb characteristic of this variety of dislocation. The psoas and iliacus, together with the anterior crural nerve between them, are stretched tightly over the head of the bone; the femoral vessels are displaced to its inner side.

III. 138.—The left hip-joint of a man, aged forty-six. The head of the femur has left the acetabulum and is lodged beneath the anterior inferior spine of the ilium upon the pectineal eminence, the great trochanter pointing directly backwards. The tendon of the psoas winds round the head to reach the lesser trochanter, the iliacus muscle is stretched over the inner portion of the head, and between the two muscles lies the anterior crural nerve. The femoral vessels are to the inner side of the head of the bone.

III. 43.—A hip-joint, exhibiting dislocation of the femur, which occurred many years before death. The head of the femur has been thrown upwards and forwards, and is lodged in a cavity, formed in part by new bone and in part by what appeared to be the displaced cotyloid ligament, at the margin of the ilium, in the situation of the anterior inferior spine. The ligamentum teres is flattened and elongated, but it retains its natural connections; bristles are placed between the two portions of this ligament, which are attached to the margin of the original acetabulum.

II. *The irregular dislocations.*

Subspinous.

The head of the femur rests immediately below the anterior superior spine of the ilium, the head looking forwards and the trochanter backwards.

This dislocation is regarded by Bigelow as a variety of the pubic, and is described by him, together with the latter, under the name of pubic and subspinous.

III. 138.—A left hip-joint. The head of the femur has left the acetabulum and is lodged beneath the anterior superior spine of the ilium, the great trochanter pointing directly backwards.

Downwards and backwards into the lesser ischiatic notch (Wormald's dislocation).

III. 56.—A hip-joint, exhibiting a dislocation of the head of the femur downwards and backwards, which occurred twelve hours before death. The head of the bone is situated on the ischium opposite to the lesser ischiatic notch and the upper part of the tuberosity. The tendon of the obturator internus is torn from its muscular fibres; some of the fibres of the pyramidalis, gemelli and gluteus minimus are also torn. There is also a fracture extending through the os innominatum near the acetabulum.

Downwards and backwards upon the ischium, near its spine.

III. 68.—A hip-joint, in which a dislocation of the femur occurred a week before death. The capsule has been opened in front. At the back part of the joint is the wide laceration in the capsule which was made by the head of the femur in its dislocation from the acetabulum.

It was supposed that the dislocated head of the femur was situated upon the ischium, close to its spine. A portion of the posterior part of the rim of the acetabulum, in the presumed direction of the dislocation, is separated by fracture. Upon the front part of the joint there is also a detached portion of the rim of the acetabulum connected with the capsule. The surface of this piece of bone is very smooth, and is adapted to a corresponding surface of the ilium immediately below the anterior inferior spine; and above this surface there is a deposit of bone, making it probable that the changes in this part of the joint were the result of some injury previous to the dislocation.

DISLOCATIONS OF THE PATELLA.

The patella may be dislocated outwards, inwards, upwards, and edgeways. The outward dislocation is the most common; the upward can only occur when the ligamentum patellæ has been ruptured or divided.

Outwards.

III. 111.—A knee-joint, of which the patella was dislocated outwards long before death, and was not reduced. The patella rests on the outer surface of the external condyle of the femur, on which, in adaptation to it, a small articular surface has been formed by a layer of very dense and polished ligamentous tissue. The tendon of the quadriceps femoris lies on the outer side of the femur, and the ligamentum patellæ is directed slightly inwards as well as downwards towards the tibia which has been rotated outwards following the displacement of the patella.

DISLOCATIONS OF THE FOOT AT THE ANKLE-JOINT.

The foot, *i.e.* the astragalus, together with the other bones of the tarsus and metatarsus, may be dislocated from the tibia and fibula outwards, inwards, forwards, or backwards.

Dislocation of the foot outwards.

Displacement of the foot outwards is the most common of the dislocations at the ankle-joint. It is generally complicated by a fracture of the fibula about three or four inches above the external malleolus (Pott's fracture). The articular surface of the astragalus with the rest of the foot is wrenched from the articular surface of the tibia and fibula and carried outwards, so that the sole of the foot looks outwards and the inner edge downwards towards the ground.

The external lateral ligament is uninjured and retains the astragalus in contact with the external malleolus, so that the malleolar end of the lower fragment of the fractured fibula is carried out-

wards along with the astragalus, whilst its upper end is driven inwards, and forms a receding angle with the lower end of the upper fragment.

The internal lateral ligament is ruptured, or it may remain entire, in which latter case the tip of the internal malleolus is torn off. Occasionally "that part of the tibia which enters into the formation of the inferior tibio-fibular articulation" is broken off from the rest of the shaft and remains connected with the external malleolus (Pirrie).

Sub-series C. 69.—A foot, with parts of the tibia and fibula, exhibiting the effects of dislocation and fracture ten months before death. The foot is dislocated outwards, and the tibia is partially separated from the fibula; the internal malleolus projects an inch on the inner side of the astragalus. The astragalus also is partially separated from the scaphoid bone. The fibula has been broken into several portions just above the malleolus. These portions are firmly reunited, and there is an accumulation of bone both before and behind the articulation between the tibia and the fibula.

Sub-series C. 139.—Dislocation of the foot outwards, from a man, aged sixty-five. The tibia is separated widely from the astragalus. The fibula is fractured about an inch above the malleolus. The internal lateral ligament is torn. The external lateral ligament is entire.

Sub-series C. 107.—The lower extremities of the tibia and fibula, with the foot of an elderly woman, exhibiting the effects of an injury which occurred several years before death. The foot is dislocated outwards, so that only the outer half of the articular surface of the tibia is in apposition with the astragalus. There has been a comminuted fracture extending in various directions through the lower end of the fibula and the adjacent margin of the tibia. The separated portions of bone have been completely reunited.

DISLOCATIONS OF THE ASTRAGALUS.

The astragalus may be dislocated from the tibia and fibula, from the os calcis and scaphoid, and simultaneously from both the tibia and fibula and os calcis and scaphoid.

In the first variety the astragalus retains its connections with the other bones of the foot, but together with the latter is dislocated from the tibia and fibula; this form has already been described as dislocation of the foot.

In the second variety the astragalus retains its connections to the tibia and fibula, but the remaining bones of the foot are dislocated from it.

In the third variety the astragalus is partially or completely separated from its connections with the bones with which it articulates, viz. from the tibia and fibula above, the os calcis below, and

the scaphoid in front. The last variety is what is generally spoken of as dislocation of the astragalus.

III. 131.—An astragalus, which had been dislocated forwards, upwards, and a little outwards, with compound fracture of the external malleolus and displacement of the foot inwards. Excised on the tenth day after the accident.

Sub-series C. 90.—The foot of a child, exhibiting a partial dislocation of the astragalus from the os calcis, together with a fracture of the superior and anterior margin of the latter bone.

DISLOCATION OF THE TOES.

III. 61.—Bones of the first and second phalanx of a great toe. The bone of the second phalanx is dislocated and firmly united by bone to the upper surface of the first phalanx.

WOUNDS OF JOINTS.

Wounds of joints, when small and early closed, may be completely recovered from; otherwise they generally set up acute inflammation of the synovial membrane, which commonly terminates in suppuration and ankylosis. The appearances presented by the synovial membrane, cartilages, etc., are similar to those already described as occurring in acute synovitis (p. 122).

Wounds of joints are illustrated only by one specimen in the Museum, in which the wound was produced by a needle.

III. 126.—The head of a fibula, with some of its surrounding tissues. Below, firmly embedded in fat and cellular tissue, is part of a needle, about half an inch in length. The structures around are natural in appearance, free from thickening or induration. The needle had been driven nine years before into the front of the knee-joint when the patient was five years old. For four years it seemed to produce no disturbance; from that time onwards there was almost constantly progressive suppurating disease of the knee-joint. The patient sank after amputation from pyæmia.

CHAPTER V.

INJURIES AND DISEASES OF MUSCLES, TENDONS, SHEATHS OF TENDONS, BURSÆ, AND FASCLEÆ.

INJURIES AND DISEASES OF MUSCLES.

RUPTURE OF MUSCLES.

See V. 3, 4, 5; and III. 25 and 56.

FATTY DEGENERATION OF MUSCLE.

Fatty degeneration of muscle, in which the muscular fibres are converted into fat, and fatty infiltration, in which globules of fat are deposited between the fibres, while the fibres themselves are at first unaffected, are generally included under the term fatty degeneration; they generally coexist to some extent in the same muscle.

Fatty degeneration is frequently met with in the muscles of the aged, especially in old people who have been long paralysed or deprived of proper and sufficient nourishment; it is also of common occurrence in muscles which have been subjected to prolonged disuse, as from chronic joint disease, comminuted fracture, lead poisoning, &c.

Specimens similar to the following, in which one or more of the voluntary muscles appear completely converted into fat, are not unfrequently met with in old subjects brought into the rooms for dissection.

V. 1. A soleus muscle, completely degenerated into fat. No muscular fibres can be discerned; in their places is a fatty tissue, like that of the ordinary healthy fat, which on the posterior part is arranged in a fasciculate manner; as the muscular fibres were, but anteriorly appears lobulated or granular.

The gastrocnemius and other muscles of the back of the same leg were similarly altered. The muscles on its anterior part were pale and flabby. All its other parts appeared healthy.

OSSIFICATION OF MUSCLE.

Ossification of muscle is occasionally met with. The muscles most commonly affected are the adductor longus and the deltoid; the former in persons accustomed to excessive riding, the latter in soldiers from the constant shouldering of arms.

V. 2. Part of a vastus internus femoris muscle, with the superficial and deep femoral arteries. Large portions of the muscle are ossified. The largest portion of bone lies so close to the arteries, that it probably presented during life the characters of a pulsating tumour. See also Sub-series A. 130.

ABSCESS IN MUSCLE.

V. 30. Two psoas muscles. Externally they presented an ordinary appearance, but on cutting into them their interior was found to be filled with dried-up pus, which occupied the large cavities shown in the preparation. These, which, with their contents, usurped the place of great part of the muscles, were lined by an irregular, glistening membrane of an imperfect fibrous structure, not unlike that which often walls in a chronic abscess.

From the body of a middle-aged man brought in for dissection.

V. 31. Part of the dried-up pus removed from the cavities shown in the preceding preparation.

ULCERATION OF MUSCLE.

V. 47. A slough of the tibialis anticus muscle which was separated in a case of diffuse cellulitis of the lower third of the leg, following Syme's amputation, performed for cancer of the sole of the foot in a man aged fifty three.

TUMOURS OF MUSCLES.

Tumours, in connection with muscle, generally have their origin in the connective-tissue planes between the muscular fibres. All varieties of tumours may affect muscles; syphilitic new growths (gummata) are particularly common.

Cancer.

V. 6.—Sections of a rectus femoris muscle, in which are several large lobulated and circumscribed masses of a soft flocculent medullary substance. The muscular fasciculi are separated by the morbid growths, but appear of healthy texture.

A large medullary tumour from the axilla of the same patient is preserved in Series XXXV.

ENTOZOA IN MUSCLES.

V. 7.—Portions of a longissimus dorsi muscle, in which are specimens of the *Cysticercus cellulosæ* (Rudolphi). The cysts are placed in

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the cellular tissue connecting the muscular fasciculi. In the upper portion of the muscle are two cysts, from which the cysticerci lying loose in the bottle were removed; in the lower portion the cysticercus is attached to the interior of its cyst.

These specimens were taken from the body of an old man, in many of whose voluntary muscles similar extozoa existed.

V. 8.—Portions of muscle and liver, from a pig, in which are numerous cysts, like those in the preceding specimen, and probably, like them, containing cysticerci.

INJURIES AND DISEASES OF TENDONS.

EVULSION OF TENDONS.

Evulsion, or tearing out, of a tendon with part of its muscle, is not an uncommon injury. Several specimens follow.

V. 4.—The tendon, with part of the muscular fibres, of the flexor longus pollicis, which were torn out from a man's arm.

The patient was a butcher, whose thumb was caught by a meat-hook, on which he remained suspended till the muscle gave way. He recovered quickly from the injury.

V. 26.—The last phalanx of the right thumb, surrounded by its natural coverings and retaining attached to it the tendon of the flexor longus pollicis, which, bringing with it some of its muscular fibres, was torn out of a boy's arm, the extremity of the thumb having been caught in a machine. At the same time the bones of the forearm were bent, and the humerus fractured about its middle third.

V. 5.—Parts of the bones of a middle finger, with the tendon and some of the muscular fibres of their portion of the extensor muscle, dried.

They were torn away from their connections by the explosion of a gun while the patient's hand was resting on the muzzle.

V. 48.—A finger, with one of the tendons torn off by an injury of which a record was not made.

V. 94.—This forefinger, with the accompanying tendons, was torn off from the hand of a man by a blow from a ramrod, which had been forcibly ejected from a gun.

V. 3.—The end of a tail of a rat, with numerous long slender tendons attached to it.

THE PROCESS OF REPAIR AFTER SUBCUTANEOUS DIVISION OF TENDONS.

The process of repair after subcutaneous division of tendons has been much less completely studied in man than in the lower animals, yet "the few instances," says Sir James Paget, "in which examination has been made of human tendons, divided by

subcutaneous section, have shown that the process in man and in animals is not materially different. The chief differences are, we may believe, that, as in the repair of bones, the production of reparative material is more abundant and its organization more speedy in animals than in man."

Immediately after division the upper end of the divided tendon is drawn to some distance from the lower by the contraction of its muscular fibres. The sheath and surrounding cellular tissue become inflamed, and inflammatory material is produced around and between the ends of the divided tendon. The ends themselves become swollen and infiltrated with new material, which combines with that already formed between them. The material thus uniting the ends is converted into fibrous tissue, which undergoes shrinking and contraction, and finally assumes the characters of the original tendon, so that in some instances no trace of the division is left.

The inflammatory products, according to Sir James Paget, take little or no share in the healing of the injury, but are replaced by proper reparative material, which, by undergoing fibrous changes, leads to the restoration of the tendon.

The process of union is occasionally delayed by extensive extravasation of blood between the divided ends. Such extravasations, however, are rare.

The different stages in the process of repair, as it occurs in the lower animals (rabbits), are well illustrated in the following specimens prepared by Sir James Paget and Mr. Savory.

I. *Repair in animals (rabbits).*

V. 36.—*Twenty hours.*—Leg of a rabbit, killed twenty hours after the division of the tendo Achillis. The upper end of the tendon has retracted above three quarters of an inch, and is slightly connected to the lower portion by a soft, gelatinous, blood-speckled material effused between them within the sheath.

V. 37.—*Sixty-eight hours.*—Leg of a rabbit, killed sixty-eight hours after division of the tendo Achillis. The ends of the divided tendon are about three quarters of an inch apart, and the interval between them is filled by a firm clot of blood.

V. 38.—*Six days.*—Leg of a rabbit, killed six days after division of the tendo Achillis. The skin above has been removed; it was more firmly adherent than usual to the parts beneath, and here and there, beneath it, were small dots, the remains of minute extravasations of blood. There is a general enlargement of the tendon within the sheath where divided, the swelling tapering gradually into the natural size and shape of the tendon. The wound of the sheath is soundly and completely closed.

V. 40.—*Ten days.*—Leg of a rabbit, ten days after division of the

tendon. The ends of the tendon are connected by firm new material, in the centre of which are one or two small distinct spots.

II. *Repair in man.*

V. 221.—*Exact time not stated.*—Parts of the tibialis posticus and flexor longus digitorum of a child in whom the tendons of these muscles were divided a short time before death. The ends of the divided tendons, retracted about two lines asunder, are united by a slender bond of new formed substance.

V. 35.—Two portions of a tendo Achillis, which had been probably torn apart a short time before death. From a subject brought into the dissecting rooms.

V. 33.—*One month.*—A portion of the tendo Achillis, of a man aged thirty-two, which was divided one month before the leg was amputated.

DEPOSIT OF URATE OF SODA IN THE TENDONS.

V. 29.—A mass of urate of soda removed from around the tendons of the extensor communis digitorum. The crystals have the ordinary acicular character of urate of soda. From the body of an old woman who had long suffered from gout.

TUMOURS.

Tumours in connection with tendons are not often met with; the following are the only specimens in the Museum.

Fibrous tumours.

V. 32.—A fibrous tumour, involving and blended with the tendons of the flexor carpi radialis, palmaris longus, and flexor sublimis. It had existed, slowly enlarging, for five years, but had never occasioned the slightest inconvenience.

It was removed after death from the right forearm of a man who died from acute pneumonia.

Cancer.

V. 16.—A medullary cancerous tumour growing in the substance of the tendon of the rectus femoris muscle, immediately above the patella. The patella, divided at its centre, is seen beneath the tumour. A woman, thirty one years old, presented herself at the hospital with a tumour larger than a hen's egg, and growing either upon or, as it seemed more probable, in the substance of the patella, and expanding its walls. She stated that she first observed it seven years before; it had increased for five years slowly, but latterly its growth had been rapid. On operating, and when an incision was made into it, it appeared to be a fibrous tumour of the rectus tendon, separated from the knee-joint only by a thin layer of synovial membrane, closely adherent to its surface. As it could not be extirpated without opening the joint, it and the patella

were removed together. For a time the patient did well, but the disease returning in the scar, amputation was performed through the middle of the thigh, but she died of exhaustion. The microscopic appearance of the growth is distinctly medullary, and the secondary formation was soft, mottled, pink, and like brain matter.

DISEASES OF SHEATHS OF TENDONS.

INFLAMMATION.

A slight degree of inflammation of the synovial lining of the sheath of a tendon, accompanied by effusion into the synovial cavity (*ténosinite crépitante*), occasionally occurs, especially in the forearm, as the result of over-exertion.

A much more severe form, however, of inflammation in the sheaths of tendons, constituting one form of whitlow (*paronychia tendinosa*), is frequently met with. The inflammation, which is generally the result of a punctured or poisoned wound, although it may arise spontaneously, runs a very acute course. The sheath of the tendon becomes rapidly distended with pus, and if the tension is not relieved by a timely incision the tendon dies from the destruction of its blood-vessels. In severe cases the suppuration may spread along the sheath of the tendon into the palm of the hand, or even under the annular ligament into the forearm, whilst at the same time the periosteum covering one or more of the phalanges is destroyed, and the denuded bones suffer necrosis.

I. 101.—The second phalanx of a thumb, separated after necrosis, which was connected with a whitlow.

I. 228.—The last phalanx of a thumb, which exfoliated almost entire, in a case of whitlow.

GANGLION.

A ganglion is a cyst-like enlargement of the sheath of a tendon filled by serous fluid. Two forms are described—the simple and compound. The simple occurs generally in connection with the extensor tendons at the back of the wrist; it is regarded by Sir James Paget as a “cystic transformation of the cells enclosed in the fringe-like processes of the synovial membranes of the sheath.”

The compound consists of the dilatation of the sheaths of several of the tendons. It commonly occurs in connection with the tendons that pass under the anterior annular ligament of the wrist, and is generally spoken of as a palmar bursal ganglion.

The walls of ganglia frequently become thickened and villous-like on their internal surface. Melon-seed-like bodies, resembling

those in burssæ, are found both free in the interior and attached by slender peduncles to the walls.

V. 19.—Part of a hand and forearm, in which the sheaths of the extensor tendons of the finger and thumb have been greatly enlarged by accumulation of fluid containing small cysts. The diseased sheaths are laid open, and one of them is shown extending up half the forearm. The walls of the sheaths are thickened, their internal surfaces in many parts granular or like mucous membrane. The partitions between some of them appear to have been absorbed, so that several form one cavity.

V. 20.—A collection of numerous round and oval cysts, with soft pale walls, which were found in the diseased sheaths of tendons last described. They floated in an opaque-yellow and moderately thick fluid.

V. 21.—A collection of cysts like those last described, but rather larger and with thinner walls, which were removed from the bursa beneath the annular ligament of the forearm of a young woman.

There is a cast of the forearm, No. 120.

V. 22.—A collection of soft solid bodies, removed from the sheaths of tendons. Most of them are thin, oval, flat, sharp-edged, and smooth, like melon-seeds; some are of irregular shape or branched.

DISEASES OF BURSAE.

Bursæ, from the constant irritation to which they are exposed by pressure or friction, are liable to undergo various changes, both in their walls and their contents. The following are the conditions most frequently met with.

Simple enlargement with collection of serous fluid in the interior.

V. 25.—Part of the left knee-joint of a child, with the muscles and tendons forming the inner boundary of the popliteal space. The bursa between the tendon of the semi-membranosus and the inner head of the gastrocnemius is enlarged, so as to form an elongated oval, lobed cyst, about two inches in length, and an inch and a half in width.

Enlargement of the bursa in this situation is common. From the fact that the bursa frequently communicates with the joint, it is unwise to inject with tincture of iodine or other stimulant, as such treatment has sometimes set up destructive inflammation of the joint.

Simple enlargement, with collection of melon-seed-like bodies in the interior.

Thin, flat, oval, sharp-edged, smooth bodies, of a yellowish-white colour, resembling melon-seeds are frequently found in enlarged

bursæ. They vary from a somewhat soft to a moderately firm consistency; they are of various sizes, usually solid, occasionally hollow, and sometimes attached to the walls of the bursa by slender stalks or pedicles.

Among these bodies are sometimes found others, irregular in shape and branched, but otherwise resembling them in structure.

They appear to be formed by the coagulation of portions of fibrine contained in the fluid of the distended bursæ; or, in other instances, by small detachments of the fringe-like growths which sometimes project from the bursal walls. The bodies are sometimes found attached by slender stalks that are probably in process of formation.

V. 12.—A shoulder-joint, exhibiting an enlargement of the bursa between the deltoid muscle and the capsule. The lining of the bursa is smooth, like the surface of a serous membrane. At the bottom of the bottle are numerous melon-seed-like bodies.

V. 22.—Melon-seed-like bodies from an enlarged bursa.

V. 17.—In this specimen the melon-seed-like bodies lying at the bottom of the bottle are hollow.

V. 28.—In this specimen many of the bodies are attached by slender pedicles to the bursal walls, and are of an irregular lobulated shape.

Enlargement with fibrous bands stretching across the interior.

These bands or cords are probably produced in part by the stretching and elongation of inflammatory adhesions, and in part (in the case of adventitious bursæ) by portions of fibrous tissue, which were left stretching across the cavity as the bursa was developed.

V. 13.—Two enlarged bursæ, removed with the integuments from over the patellæ of the same person. The walls of both the bursæ are thick, tough, and laminated, and cords are attached by one or both extremities to their internal surfaces.

V. 14.—A similar specimen, except that the bursa was distended by a honey-like fluid.

V. 15.—A similar specimen, removed after death, with the patella and other parts. The enlarged bursa is laid open from the front, showing its interior traversed by numerous slender tendinous cords, from some of which lobulated growths are suspended.

V. 27.—Part of a patella, with its bursa lying on its anterior surface. The bursa is enlarged, the walls thickened, and tough fibrous cords pass across its interior, running almost horizontally from side to side, attached at either extremity, but free in the rest of their extent.

Enlargement with thickening of the walls.

The thickening of the walls is due either to the concentric deposit of fibrine in the interior of the bursa, or to inflammatory infiltration of the walls themselves.

The thickening may proceed to such an extent as to completely fill the cavity of the bursa, which is thus converted into a solid tumour.

Bursæ are, moreover, liable to acute attacks of inflammation, which frequently terminate in suppuration. Syphilitic gummata in their interior are also not uncommon.

There are no specimens of acute or syphilitic inflammation of bursæ in the Museum.

V. 28.—An enlarged bursa, removed from over the patella. Its walls are greatly thickened, and its interior is about half filled with tendinous cords and lobulated growths. Many of the latter are attached by slender pedicles, and are loosely suspended from the walls.

V. 16.—An enlarged bursa, removed with the integuments from the front of the patella. The walls of the bursa are between two and three lines in thickness, tough, fibrous, and laminated, and its cavity was nearly filled by a substance like fibrine or imperfect false membrane, some of which is still attached to its internal surface.

V. 18.—Two bursæ, which were removed from the anterior surfaces of the patella of the same person. In each specimen the cavity of the bursa is almost completely obliterated by the formation of a firm fleshy substance in it, thickening its walls.

V. 17.—Sections of a diseased bursa, which was removed from the front of the patella. In consequence of long-standing disease, its walls have become from one to four lines in thickness, and very hard, tough, and coarsely fibrous. Its internal surface is irregular, and its cavity was filled by a small quantity of yellow fluid, in which the small white bodies, now lying at the bottom of the bottle, were contained.

INJURIES AND DISEASES OF FASCIÆ.

CONTRACTION OF THE PALMAR FASCIÆ.

V. 23.—Part of a hand, in which the middle and ring fingers were permanently flexed, in consequence of the thickening and contraction of the portions of the palmar fascia connected with them.

CHAPTER VI.

DISEASES AND INJURIES OF THE SPINE.

ANGULAR CURVATURE.

ANGULAR curvature, also called Pott's curvature, because it was first accurately described by Percival Pott, is produced by the destruction of one or more of the bodies of the vertebræ and intervertebral cartilages, and the consequent falling forwards of the upper portion of the spine so as to form an angle with the lower. It must be distinguished from lateral curvature, which is produced by the unequal compression of the intervertebral cartilages, and is unaccompanied by ulceration of the bodies of the vertebræ.

Angular curvature is generally met with in strumous children; its usual situation is in the dorsal region, but it may occur in any part of the spine.

It is generally held that the destruction of the vertebræ and intervertebral cartilages is the result of strumous caries beginning in the bodies of the vertebræ; but there are some, among whom is the author, who maintain that the intervertebral cartilages are more often the first to suffer than is generally allowed. For in many specimens, as pointed out by Drs. Wilks and Moxon, "a vertebra is often found apparently destroyed in its middle by disease, but on closer examination the two portions, which appear to be the remains of one, are found to belong to two separate bones, the disease having commenced between them." Again, the occasional occurrence of angular curvature of the spine in otherwise healthy adults, where there is some authentic history of a blow or fall upon the back, renders it probable that the affection sometimes begins in a slight laceration of the intervertebral cartilages, followed by destructive inflammation of the intervertebral joint, and afterwards by ulceration of the contiguous vertebræ. Moreover, in such specimens, the healthy condition of the vertebræ above and below those actually breaking down lends further support to this view, for in strumous caries the vertebræ above and below are softened and infiltrated with caseous material. The appearances presented by the

disease as it begins in one or other of these ways may be studied in the following specimens.

I. BEGINNING IN THE BODIES—STRUMOUS CARIES.

In the bodies the disease begins either as strumous osteitis or as a "deposit" of miliary tubercle. As described under struma of bone, the inflammatory material, or miliary tubercle, as the case may be, rapidly undergoes caseous change, and, together with the osseous trabeculae, breaks down and disintegrates, leading to the destruction of the affected vertebrae and subsequent ulceration and destruction of the neighbouring intervertebral cartilages. The characteristic yellow, cheesy appearance of the caseous material infiltrating the affected vertebrae, and the ulceration of those vertebrae in which the disease is more advanced are seen in the following specimens.

IV. 14.—Section of a spine, with angular curvature. The disease is situated in the middle of the dorsal region of the spine; a large portion of the bodies of two vertebrae are destroyed by ulceration. The bodies above and below the seat of disease are filled with caseous-looking material. The patient died of phthisis.

See also IV. 15, 16, 43, and 44.

II. BEGINNING IN THE INTERVERTEBRAL CARTILAGES—DESTRUCTIVE INFLAMMATION OF THE INTERVERTEBRAL JOINTS.

When the intervertebral cartilages are first affected, it is probably either as the result of a slight laceration or other injury of the intervertebral cartilage, such as may occur from sprains or blows upon the back, or of a low form of inflammation (strumous) of the intervertebral joint. In whichever way it begins, the inflammation terminates in ulceration of the cartilage, and subsequent ulceration and destruction of the contiguous vertebral bodies.

IV. 20.—Section of a spine, exhibiting disease in the dorsal and lumbar vertebrae. Between two of the lower dorsal vertebrae the intervertebral cartilage is completely destroyed, and the adjacent surfaces of the bodies of those vertebrae are slightly ulcerated. See also IV. 21.

Production of the angular deformity.

No matter how the disease originates, the affected bodies and intervertebral cartilages, as we have seen, finally break down and disintegrate, and so leave a gap between the vertebra above and that below. Partly by its own weight and partly by the dragging of the abdominal muscles, the upper portion of the spinal column, thus undermined, falls forward, and necessarily forms an angle at

the seat of the disease with the lower portion. When the disease occurs in the dorsal region, the normal lumbar and cervical curves will be greatly increased by the efforts made to maintain the body in an upright position; the angular projection is consequently thrown backwards, and the well-known hump-back produced. When the disease occurs at the lower end of the spinal column, there is no means of restoring the balance; the body therefore always remains tilted forwards, and walking or standing in an upright position is rendered impossible.

Sub-series D. 30.—A spine, thorax, and pelvis. There has been ulceration of the bodies of the lumbar vertebræ, and of the sacrum in its whole extent. Four of the bodies of the lumbar vertebræ are destroyed, and an angle is formed by the approximation of the vertebræ above and below the situation of the disease; but their union by bone is incomplete. The thorax is depressed anteriorly, so that a space of only two inches and a half intervenes between the ensiform cartilage and the ossa pubis, and the false ribs nearly touch the crests of the ilia. All the ribs arch upwards, and the sternum arches forwards.

Sub-series D. 28.—The dorsal portion of a spine, with acute angular curvature, in consequence of destruction of the bodies of three vertebræ. The aorta, upon the altered part of the spine, forms a very acute angle, which is directed backwards in correspondence with the angle of the spine itself.

Sub-series D. 34.—A spine and pelvis. The spine presents an acute angular curvature in its dorsal region, the consequence of the destruction by ulceration of the bodies of the last nine dorsal and the first lumbar vertebræ. Two of the ribs are united by bone to the spine. The pelvis is well formed.

Sub-series D. 29.—A spine, with very acute angular curvature. See also IV. 14, 15, 16, 21, and 23.

Spinal abscess.

In some instances it would appear that the disease may terminate favorably without the formation of an abscess. It more commonly happens, however, that the caseous material and partly destroyed vertebræ break down into pus, which collects in front of the diseased vertebræ in the angle formed by the falling down of the upper portion of the spine upon the lower. The periosteum and anterior common ligament, being naturally relaxed by the bending forward of the spine, readily yield, along with the pleura or peritoneum, as the case may be, to the pressure of the pus, and, becoming thickened and consolidated, form the abscess wall. The pus, which is prevented from going upwards by the overhanging of the spine, downwards over the front of the spine by the attachment of the common ligament, and backwards in consequence

of the bodies being generally less diseased posteriorly, makes its way downwards by the side of the spine, and finally points somewhere to the surface. When the disease occurs in the cervical region the abscess will point to the side of the neck or back of the pharynx (cervical or post-pharyngeal abscess). When in the dorsal or lumbar region the pus will make its way either downwards or backwards, by the side of the spine, giving rise to a psoas or lumbar abscess.

Psoas abscess.—As already stated this may result from disease in either the dorsal or upper lumbar region.

When it is due to disease in the dorsal region the pus makes its way downwards by the side of the spine, being prevented from passing backwards by the resistance of the ribs. On reaching the diaphragm it passes under the ligamentum arcuatum internum, and entering the sheath of the psoas descends in the substance of that muscle, and finally points under Poupart's ligament, external to the femoral vessels.

Lumbar abscess.—This may also be due to disease in either the lumbar or dorsal region. The pus, meeting with some resistance, does not enter the sheath of the psoas, but makes its way backwards through the quadratus lumborum and protrudes in the lumbar region, external to the erector spinæ.

IV. 14.—Section of a spine with angular curvature. The disease is situated in the middle of the dorsal region of the spine, and large portions of the bodies of two vertebræ are destroyed by ulceration. A soft caseous matter is deposited around the diseased bone, and is so abundant in front and at the side of the spine that it elevates the periosteum of the vertebræ and the pleura costalis in the form of an abscess within the chest. A small piece of bone is separated from the rest by ulceration, and is embedded in the caseous matter behind the ulcerated vertebræ.

IV. 40.—The last nine dorsal and the first lumbar vertebræ of a child. The body of the eleventh dorsal vertebra is nearly destroyed, and those of the eighth, ninth, and tenth are completely destroyed by ulceration. The space left by their removal is diminished by the approximation of the vertebræ above and below, producing an acute angular curvature of the spine, and is bounded in front by the periosteum and ligaments of the vertebræ detached and raised up over a collection of purulent fluid. The detachment of the periosteum is also continued over the front of the bodies of the seventh, sixth, and fifth dorsal vertebræ, and these are hollowed out, except at their borders, by ulceration. The intervertebral cartilages, from the eleventh vertebra to the eighth, are destroyed, but those above appear scarcely diseased. The posterior common ligament is raised and made to project into the spinal canal by purulent, and probably tuberculous, matter collected behind the remains of the ulcerated vertebræ.

II. 58.—A hip-joint, from a young woman, in which the articular cartilages of the femur and acetabulum have been removed by ulceration, and the exposed surfaces of the bones are covered by soft granulations and flakes of lymph. The capsular ligament is thickened, and the head of the femur and the acetabulum appear enlarged. At the anterior and inner part of the capsule there is a large oval opening with smooth defined margins. This opening was immediately beneath the tendon of the psoas and iliacus muscles in the situation at which the bursa naturally existing beneath that tendon sometimes communicates with the cavity of the hip-joint.

A large psoas abscess had long existed in this patient, and it seemed probable that the pus having passed under the tendon of the psoas and iliacus muscles, and through the aperture of communication between the bursa and the joint, had excited acute inflammation of the latter.

IV. 41.—Section of a spine from the sixth dorsal to the second lumbar vertebræ. The bodies of the ninth and tenth dorsal vertebræ, and the portion of the fibro-cartilage between them, are destroyed by ulceration, and the approximation of their remains has produced an angular curvature of the spine. The periosteum, with the anterior vertebral ligament, is detached both from these two and from the eighth and eleventh dorsal vertebræ, and is raised over a collection of purulent fluid which projected into the posterior mediastinum, and appears to have communicated below with a psoas abscess.

Progress of cure.

As already stated, when the vertebræ and intervertebral substance are destroyed, the upper portion of the spine falls forward upon the lower. If the subject of the disease now be kept at rest, union of the approximated vertebræ takes place. This union is greatly expedited by the changes which occur in the posterior segments of the spinal column. Thus, the ligaments uniting the arches and processes become greatly thickened, binding these parts firmly together, whilst at the same time the articular joints generally become inflamed and afterwards ankylosed, and so act as a kind of splint, which keeps the approximated bodies firmly in position. If the bodies are well in contact before the consolidation of the posterior segment takes place, true bony ankylosis of the bodies will occur. But if the loss of substance is very great, and the parts become fixed by the changes which occur in the posterior segment before the bodies come completely into contact, bony ankylosis will not occur, and the gap thus left will be filled up by the remains of the abscess and a certain amount of fibrous tissue.

IV. 15.—Section of a spine, exhibiting disease in three of the bodies of the lower dorsal vertebræ, which was in progress towards its cure.

IV. 17.—Portion of the spine of a child. The bodies of four of the

lower dorsal vertebræ are destroyed, and the anterior parts of the bodies of the vertebræ which were immediately above and below the situation of the disease are approximated and firmly united by bone.

IV. 23.—Section of a spine, exhibiting the process of reparation after extensive disease. Twelve spinous processes are shown in the preparation, but the bodies of only four vertebræ; eight bodies, therefore, have been destroyed. The vertebræ above and below these eight have been approximated, and are firmly united by bone with their remains and with one another.

IV. 48.—Section of the lower dorsal and the first lumbar vertebræ. The former, the seat of old disease, have their bodies broken down and crushed together. In this condition they have become consolidated.

Condition of spinal canal and cord.

The spinal canal, constituting as it does a part of the posterior segment of the column, with the exception of being bent, is seldom materially interfered with; its calibre at the angle is not, as a rule, diminished; sometimes it is even enlarged. Occasionally, however, it is encroached upon by portions of bone separated from the vertebræ, and occasionally it is perforated by pus from an abscess.

As the bending of the canal generally takes place slowly, the functions of the spinal cord are seldom impaired; sometimes, however, when the bending takes place less slowly, a certain amount of paralysis occurs in the parts below. Under these circumstances impairment of motion is more common than that of sensation, a fact easily explained by the closer proximity of the anterior or motor columns to the bodies of the vertebræ than the posterior or sensory. The patient usually recovers from the paralysis, but at times the cord is so pressed upon that it becomes soft and diffuent.

Sub-series D. 11.—Section of a spine, in which there has been destruction by ulceration of the bodies of six of the dorsal and lumbar vertebræ. The vertebræ above and below the seat of the disease have been approximated and firmly united by bone. There is an acute angular curvature of the spine, but the diameter of the canal which contained the medulla spinalis is not lessened; rather, by the extensive destruction of the bodies of the vertebræ, it is increased where the angle is most prominent. See also IV. 36.

IV. 34.—The upper half of a spine, in which the bodies of the fifth and sixth cervical vertebræ are completely, and those of the fourth and seventh are partially, destroyed by ulceration. There is angular curvature in the lower part of the cervical region, and the remains of one of the bodies of the vertebræ projects far into the spinal canal.

From a child ten years old. There was a large collection of matter in front of the spine pressing in the pleuræ.

IV. 35.—Part of the dorsal portion of a spine. The anterior half of the body of the seventh dorsal vertebra is almost entirely destroyed by ulceration, and the body of the sixth is deeply ulcerated on its anterior surface. By the approximation and union of the sixth and eighth vertebrae an angular curvature of the spine has been produced. A small rough process of bone has grown from the most prominent part of the angle into the spinal canal. Opposite to this projection the spinal cord was softened and reduced in size.

VII. 7.—Part of a spinal cord from the same case as that from which the above specimen was taken. A portion of it, about half an inch in length, is soft and reduced to less than half its natural size.

IV. 48.—Section of the lower dorsal and first two lumbar vertebrae. The spinal canal at and above the curve is slightly narrowed. The cord is compressed in this situation.

IV. 42.—Section of a child's spine, from the second cervical to the third dorsal vertebra. A collection of purulent fluid existed between the diseased vertebrae and their periosteum, both in front of the bodies and behind them, and part of it was discharged by ulceration into the spinal canal.

DISEASE OF THE TWO UPPER VERTEBRÆ AND OF THE ARTICULATIONS BETWEEN THE ATLAS AND OCCIPITAL BONE.

Disease of the two upper vertebrae and of the articulations between the atlas and occipital bone, from the fact that the atlas has no body, and that there are no intervertebral cartilages between the axis and atlas, and between the atlas and occipital bone, differs from the disease of the other vertebrae, which, as we have seen, chiefly attacks the bodies and intervertebral cartilages. It therefore requires a separate description.

The articulations between the axis and atlas, and between the atlas and occipital bone resemble other synovial joints, and are subject to similar diseases. The affection, however, to which they are most liable is that which is commonly designated "strumous disease." The articulations between the atlas and axis are those most frequently attacked, the disease beginning either as a low chronic inflammation of the synovial membranes or as caries of the odontoid or articular processes. The pathological changes which ensue are the same as those already described under strumous disease of the joints. The cartilages, and subsequently the bones, become ulcerated, and the ligaments softened, elongated, or destroyed. The disease may terminate in sudden death from the giving way of the transverse ligament or the separation of the odontoid process, and the consequent compression of the upper part of the spinal cord through the sliding forward of the atlas upon the axis. As the ligaments, however, retaining the atlas in contact with the axis

generally yield but slowly, and as the thickening of the parts around the affected joints further tends to keep the bones in apposition, the displacement of the atlas is usually very gradual; the cord, under these circumstances, escapes sudden compression, and neither death nor paralysis occurs.

If the parts are kept properly at rest the disease may terminate in ankylosis, and the patient escape with permanent deformity and a stiff neck.

Strumous inflammation of the interarticular joints.

IV. 38.—Section of the upper part of the spine, of the occipital bone, and of the spinal cord. The connections of the second cervical vertebra, with the first, and with the occipital bone, had been destroyed, apparently by ulceration, and the anterior portion of the first vertebra and the basilar portion of the occipital bone have sunk down, so that the lower margin of the first vertebra is within a line of the upper margin of the intervertebral substance between the second and the third; and the whole of the odontoid process of the second projects straight upwards into the cavity of the skull. The medulla oblongata is thus lifted up and stretched over the apex of the odontoid process, and as the pons retains its connection with the basilar portion of the occipital bone the axis of the medulla oblongata forms a right angle with the axis of the spinal cord. The displaced bones are held together by the thickened and consolidated adjacent tissues. Their texture appears indurated, but not otherwise diseased.

The patient was a woman thirty-two years old. The most prominent sign of the disease, which was of four years' duration, was a constant acute pain at the base of the neck, just below the occiput. She had some difficulty in swallowing, and used to sit with her chin on her hand, or resting on her sternum; but she suffered no loss of sensibility, and was able to walk the day before her death.

Caries of the odontoid process

IV. 46.—First and second cervical vertebræ, with part of an occipital bone. The odontoid process of the axis, softened and ulcerated, is fractured across its base, just below the level of the transverse ligament. The latter, as well as the other adjacent structures, retain a natural appearance.

From a woman, aged thirty-six years, who had enjoyed good health until four months prior to her death. She then began to complain of obscure pains about the back of the neck, which persisted. In moving about she carried her head stiffly, and always expressed a dread of moving it suddenly. One morning while stooping over a tub, her head fell forward and she was seen to drop. When picked up a few seconds later she was dead.

IV. 19.—Portion of a spine, in which the bodies of the second and third cervical vertebræ are partially ulcerated. The remaining bone is

softened and yellow. The odontoid process has been completely separated at its base from the body of the second vertebra.

Dislocation of the atlas.

IV. 49.—An atlas and an axis. The odontoid process has been dislocated in such a manner as to leave only a very narrow space for the spinal cord, and the bones have subsequently become ankylosed.

They were found in a graveyard at Aberdeen.

IV. 27.—Portion of an occipital bone with the atlas. The atlas is displaced towards the left side. Its right half, projecting into the foramen magnum, considerably diminishes the size of the aperture.

Ankylosis of the interarticular joints.

IV. 26.—Portion of an occipital bone, with the three uppermost cervical vertebræ. The occipital bone and the anterior half of the atlas are firmly and completely united by bone. The second and third vertebræ are similarly ankylosed at their articular processes. These changes seem to have followed ulcerative disease, by which the odontoid process and the body of the second vertebra were changed in structure, and in part removed.

IV. 33.—Portion of an occipital bone, with the first and second cervical vertebræ. There is a nearly complete osseous union of the two vertebræ, and the odontoid process appears to have been superficially ulcerated. The anterior arch of the atlas exhibits a line of fracture; but it does not appear probable that the ankylosis of the vertebræ was the consequence of the fracture.

IV. 28.—Second and third cervical vertebræ, firmly united by bone, which has been chiefly formed round their articulations. Part of the odontoid process has been destroyed by ulceration.

LATERAL CURVATURE.

Lateral, unlike angular curvature, is due, not to ulceration of the bodies of the vertebræ or intervertebral cartilages, but to an unequal compression of the intervertebral cartilages from the habit of sitting or standing in one-sided positions. Hence it is common in young debilitated girls, whose muscles and ligaments are relaxed, or in subjects in whom a one-sided position of body is induced by the shortening of a limb the result of disease or injury. It is also a common accompaniment of rickets.

The primary curve is almost always convex towards the right; it generally occurs in the dorsal region, and is accompanied above and below by compensatory curves, *i.e.* curves whose direction is opposite, and sweep equal to that of the primary curve; the lower or lumbar curve is generally more marked than the upper or cervical.

The vertebræ and intervertebral cartilages are healthy, the former but little, if at all, altered in shape, the latter compressed wedge-wise, the base of the wedge looking towards the convexity of the curve, so that the transverse processes on the convex side are widely separated, while those on the concave side are approximated. In addition to the lateral deviation, the vertebræ are rotated on their own axes, so that the front of the bodies is directed towards the convexity of the curve, and the spinous processes towards the concavity, while the transverse processes on the convex side project backwards, and those on the concave side forwards. The ribs on the convex side of the curve, like the transverse processes, are abnormally separated, and with them are carried backwards by the rotation of the spine. They are at first directed downwards, lying nearly in contact with the bodies of the vertebræ, and then bending abruptly round the bodies of the vertebræ are directed forwards and inwards towards the sternum, so that the cavity of the thorax on the side corresponding to the convexity of the curve is increased in its antero-posterior and diminished in its lateral diameter. The ribs on the concave side are crowded together in the concavity of the curve, are carried forwards with the transverse processes, and are directed almost horizontally first outwards and then straight forwards, only their extreme ends and their cartilages being directed inwards to the sternum (Sub-series D. 16). The cavity of the thorax on the side corresponding to the concavity of the curve, therefore, is increased in its lateral but diminished in its antero-posterior diameter. The sternum retains its natural position in the middle line, and the scapula on the convex side is more prominent and placed at a greater distance than is natural from the spinous processes.

The projection backwards of the posterior parts of the ribs on the convex side of the curve is in some cases greatly marked, so that a deep longitudinal furrow is formed, limited mesially by the spinous processes, and laterally by the posterior parts of the ribs.

The hump is formed by the angles of the ribs and the transverse processes on the convex side of the primary curve.

Sub-series D. 16.—A spine, thorax and pelvis, from an adult woman. All the dorsal and the first two lumbar vertebræ are comprised in a lateral curve, the convexity of which is directed to the right, and backwards. There are slight compensating curves in the cervical and lower lumbar regions of the spine. The bodies of the vertebræ and intervertebral spaces are much deeper in the convexity than in the concavity of the curve; they are also twisted round, so that what were their anterior surfaces are directed outwards, towards the convexity of the curve; this outward direction being chiefly observed in those vertebræ which

are in the middle of the curve, while those at each end of it gradually approach nearer to their natural direction. Connected with this twisting of the bodies of the vertebræ is a narrowing of the space between the spinous processes and the right transverse processes of the vertebræ, i. e. the vertebral groove, although the spinous processes are directed rather towards the left side, that is, towards the concavity of the curve. The space between the spinous and left transverse processes is somewhat increased in width and depth. The thorax presents the characteristic appearance usual in lateral curvature.

The cavity of the pelvis is of ordinary size, but its antero-posterior axis, in correspondence with the obliquity of the lumbar vertebræ, is directed obliquely, from before backwards, and from right to left.

Sub-series D. 21.—A spine and sacrum. The spine presents two lateral curves; one in the dorsal region directed to the right, the other in the inferior dorsal and lumbar region directed to the left. The changes in the form and direction of the vertebræ are similar to those shown in D. 16, but less in degree.

See also Sub-series D. 22, 23, and 26.

Sub-series D. 24.—A spine and pelvis, similar to those marked D. 16. There is considerable deposit of bone enlarging and surrounding the articular processes of those vertebræ which are comprised in the concavity of the curve; a change which may also be observed, in various degrees, in many of the other specimens of lateral curvature.

Sub-series D. 32.—A spine with two lateral curves in its dorsal region and one in the lumbar. The principal curve is in the superior dorsal region and is directed to the right side. The bodies are thinner on the concave than on the convex side of each curve, and there are thin growths of bone from their edges overlapping the thinner intervertebral cartilages in each of the concavities of the curves.

Sub-series D. 25.—A spine, thorax, and pelvis. The middle of the dorsal region of the spine is strongly curved towards the left, and there are compensating curves convex to the right above and below this. The description of Sub-series D. 16 will almost exactly apply to this specimen, except that in this the primary curve is directed to the left, in that to the right, and in this the thorax is less flattened at its sides.

POSTERIOR CURVATURE—CYPHOSIS.

In posterior curvature or cyphosis the spine is curved with its convexity backwards, but, unlike angular curvature, it is not dependent upon destruction of the bodies of the vertebræ and intervertebral cartilages. It generally occurs in the dorsal region, and is then merely an exaggeration of the normal curve of the back. Like lateral curvature it is commonly the result of muscular debility and relaxation of the spinal ligaments, and of unequal compression of the intervertebral cartilages. It also occurs in rickets, and to a slight extent in most persons who are accustomed to much stooping.

In consequence of the deformity of the spine the pelvis is generally increased in its antero-posterior diameter, but diminished in its lateral.

Sub-series D. 18.—The spine of an aged person, which, in its whole extent, is curved with the convexity backwards, and a little to the right. The bones are all healthy, but light.

Sub-series D. 20.—A similar specimen.

Sub-series D. 17.—A spine, thorax, and pelvis. The spine in its dorsal region is curved with its convexity backwards and a little to the right. The thorax, projecting very far forwards, is flattened at its sides; its transverse diameter is only five inches; its antero-posterior diameter is eight inches and a half.

Sub-series D. 38.—Bones of the trunk of an old woman. The dorsal portion of the spine is deeply curved backwards. The dorsal vertebræ are reduced in size anteriorly, but their texture is not distinctly altered. Between the ninth and tenth there is a deposit of new bone. The antero-posterior diameter of the chest is augmented, and the sternum is much curved forwards, but the height and width of the chest are diminished, the ribs anterior to the angles being nearly straight, and some of the lower intercostal spaces being almost obliterated.

ANTERIOR CURVATURE—LORDOSIS.

Anterior curvature or lordosis nearly always occurs in the lumbar region; it consists in an increase of the normal lumbar curve. Like lateral and posterior curvature it is the result of the unequal compression of the intervertebral cartilages, and not of the destruction of the bodies of the vertebræ or intervertebral cartilages.

Lordosis in a slight degree is a frequent accompaniment of rickets and disease of the hip-joint.

RARER FORMS OF DISEASE OF THE SPINE.

DISEASE OF THE ARCHES OF THE VERTEBRÆ.

IV. 22.—Portion of a spine, exhibiting ulceration of the arches of the vertebræ. The left halves of the arches of the fifth, sixth, and seventh cervical vertebræ are almost completely destroyed. A portion of the ulcerated bone was separated, and pressed upon the spinal cord. The remaining portions of the bones are of their natural texture.

CHRONIC RHEUMATIC ARTHRITIS.

II. 71.—A lumbar vertebra with chronic rheumatic disease, more especially of its articular processes.

TUMOURS OF THE SPINE.

The vertebræ may be the seat of any of the tumours which ordinarily affect bone.

Enchondromata.

I. 115.—A cartilaginous tumour invading the spinal canal through the intervertebral foramina. The growth appears to originate in the heads of the ribs.

Spindle-celled sarcomata.

IV. 47. Lower cervical vertebræ with a growth involving the body of the sixth. Everywhere the outer wall of this bone is pushed irregularly before it, forming in front a considerable nodulated prominence, and behind, a less marked and smooth projection. On either side the tumour has made way through its bony envelope, involving the sixth transverse process, and projecting laterally through the fifth and sixth intervertebral foramina. At the last-named points it involves, chiefly on the right side, the nerves which principally form the brachial plexus. The vertebral arteries pass through the lower end of the tumour, and the canal of the right is somewhat narrowed.

The spinal cord is compressed by the expansion of the posterior wall of the body of the sixth cervical vertebra, the antero-posterior diameter being lessened chiefly upon the right side. A portion of bone is separated from the remainder of the body to show the extent of encroachment upon the canal. The woman from whom this preparation was obtained died with spindle-celled sarcomata originating in the uterus produced as a secondary formation in the pericardium, lungs, and in the body of the sixth cervical vertebra. Before death she suffered from paralysis, more especially of the right arm and leg.

Melanotic sarcomata.

I. 190.—Melanotic growths in the cancellous texture of the lumbar vertebræ.

Scirrhus cancer.

IV. 39.—Sections of seven dorsal vertebræ, from a man who died with scirrhus cancer of the breast and other organs. Five of these vertebræ are affected with scirrhus cancer. In the first and last two the cancellous tissue is filled, and in great measure displaced by firm greyish substance, which had exactly the same characters as the cancer of the breast. Of the two middle vertebræ nothing remains but fragments, infiltrated with cancerous substance, and enclosed in a cavity which was filled with other detached fragments and softened cancer. The intervertebral substance between these two vertebræ is disorganised, and its remains lie in the cavity with their fragments; the corresponding substances between the vertebræ above and below are softened at their centres.

FRACTURE OF THE SPINE.

Fracture may occur in any part of the spine, but is most frequent in the cervical region. The character and extent of the injuries sustained by the vertebræ and their connecting ligaments vary con-

siderably, according as the fracture is produced by direct or indirect violence. The condition of the parts can therefore be conveniently studied under the heads of fracture from direct and fracture from indirect violence.

FRACTURE FROM DIRECT VIOLENCE.

As direct violence can necessarily only be applied to the spinal column posteriorly, it falls primarily upon the spines and arches of the vertebræ. Hence, when the force is but moderately severe, the spines may be fractured or detached without implication of the spinal canal or vertebral bodies; or the fracture may extend to the arches on one or both sides, the bodies still escaping. When, however, the fracture is the result of a very severe blow, such as that from a crane, or of a fall from a great height upon the back across a wall or beam, the spine is, as it were, bent violently backwards, tearing asunder the structures constituting the anterior segment of the column and crushing those constituting the posterior. Hence the bodies of the vertebræ are generally found uninjured, but wrenched apart, the intervertebral substance ruptured, and the anterior common ligaments torn; whilst the arches of the vertebræ, the articular processes and spines are fractured and crushed.

In injury from this form of violence the vertebræ above the seat of fracture are very frequently displaced forwards, as the articular processes being fractured and the intervertebral substance torn, nothing remains to retain the vertebræ in position.

IV. 7.—Portion of a spine, in which the right half of the posterior arch of the atlas has been completely detached by fracture.

Sub-series D. 1.—Portion of a spine, in which a fracture extends obliquely through the body of the tenth dorsal vertebra, its superior articular processes, and the inferior articular and spinous processes of the ninth dorsal vertebra.

Sub-series D. 2.—Portion of a spine, with oblique fractures through the arches of the fourth and fifth cervical vertebræ, and a vertical fracture through the body of the fifth.

Sub-series D. 3.—Portion of a spine, with a transverse fracture through the body of the twelfth, and a vertical one through that of the eleventh, dorsal vertebra.

IV. 6.—Portions of a spine, in which there is an extensive comminuted fracture of the arches and bodies of the fifth, sixth, and seventh cervical, and first dorsal, vertebræ.

IV. 59.—The first lumbar vertebra of a man, from whom specimen VII. 17 was taken. Through the body there is a nearly horizontal fracture. When examined the cleft was a little open in front, but there was no material displacement of either fragment.

FRACTURE FROM INDIRECT VIOLENCE.

When the violence is indirect, such as that received in a fall from a great height upon the head, or from catching the head in travelling under a tunnel, or from a heavy weight falling upon the head and shoulders, the spine is bent violently forwards, crushing the structures forming the anterior segment of the column and tearing apart those forming the posterior. Hence one or more of the bodies, especially their anterior part, and intervertebral substances are fractured and crushed between the vertebræ above and below, the posterior part of one of the fractured bodies being frequently driven backwards into the vertebral canal. The spines, articular processes, and arches, on the other hand, are wrenched asunder, and their connecting ligaments torn.

Fracture of the sternum is occasionally combined with this form of fracture of the spine from the chin coming in violent contact with the sternum as the spine and head are doubled forwards; it may be said that in such cases the thorax is broken through.

IV. 1.—Section of a spine, in which there is a fracture of a dorsal vertebra, either the third or the fourth. The front of its body is crushed between the vertebræ above and below it, and the posterior part has been driven backwards into the spinal canal, and has completely divided the cord. The spinous and articular processes of the fractured vertebræ are torn away from those of the vertebra above it, leaving a wide gap at the posterior part of the spinal column.

IV. 4.—Section of a spine, in which there is fracture of the body of the sixth cervical vertebra. The middle and fore part of the body is crushed between the two adjacent vertebræ; and its posterior part is pressed backwards into the spinal canal, so that the spinal cord must have been nearly divided. The spinous process of the vertebra retains its natural position.

IV. 64.—Specimen of fracture of the last cervical vertebra.

IV. 61.—Section of part of a spinal column in middle dorsal region. There had been dislocation between the seventh and eighth dorsal vertebræ with fracture of the body and spinous process of the former. The line of fracture can be seen in the specimen IV. 62.

CONDITION OF THE SPINAL CORD.

The spinal cord may altogether escape, as in those cases when the spines only are broken off, or the vertebræ little, if at all, displaced; or it may be completely divided or crushed; or, again, so bruised and injured that it rapidly softens and becomes diffuent. Sometimes, as in fractures from indirect violence, the anterior columns are alone injured, the posterior part entirely escaping. Under such circumstances motor paralysis only results, sensation being little, if

at all, impaired. When the fracture occurs below the second lumbar vertebra the cord necessarily escapes, as it terminates at this spot

Cord more or less divided or crushed. IV. 60.—Fracture of one of the lower cervical vertebra with displacement of the parts above and below the line of fracture. By the removal of the spines and arches of the vertebra, the spinal cord is shown to have been nearly torn across at a spot immediately opposite to the injured bone. The accident happened three months before death.

IV. 65.—Cervical spine of a boy fifteen years old, showing fracture and dislocation of the fifth cervical vertebra. The spinal cord was destroyed at the seat of injury so that there was complete paralysis of motion and sensation of all parts below. In spite of this the patient survived the accident one year and seven months.

Rupture of, and extravasation of blood into, grey substance.—VII. 11.—Section of the cervical portion of a spinal cord. Its exterior appears unchanged, but in its interior there is an extravasation of blood, with rupture of its grey substance.

The injury was produced by a forcible bending forwards of the head. One of the lower cervical vertebra was fractured and displaced.

Anterior columns injured. Posterior unaffected. IV. 53.—Section of the cervical vertebra and spinal cord of a man who was struck violently on the forehead, his head being wrenched backwards. This produced almost complete paralysis of motion from the neck downwards until his death, three weeks after the accident. Sensation was never impaired. The intervertebral substance between the fourth and fifth vertebra was ruptured, one of the tubercles of the spinous process of the fifth vertebra was crushed and lay detached, the anterior fibres of the cord corresponding to the damaged intervertebral cartilage were softened, almost diffuent and discoloured. The posterior fibres of the same part were normal.

IV. 56.—Fracture of the spine, from a heavy man, æt. 63, who fell upon his head and shoulders. The intervertebral substance between the last cervical and first dorsal vertebra had been torn through. The head and cervical vertebra have been dislocated forward in such a manner that the first dorsal vertebra presses backward upon the cord. At this point the cord is crushed, softened, and bloodstained. There was complete loss of motion below the nipple, but no loss of sensation. He died on the fifth day after the accident

Compression of the cord.—IV. 52. A portion of the spinal column and cord, including part of the cervical and dorsal regions of a boy, aged fifteen. The column and cord are divided by a vertical section. The body of the fourth cervical vertebra is crushed and driven backwards, the intervertebral substance above and below coming into contact in front, while the spinal cord is much compressed by the angular projection thus produced.

REPLACEMENT OF THE FRACTURED VERTEBRÆ BY EXTENSION.

IV. 62.—Right half of the specimen of which the left half is shown in IV. 61. It shows the almost complete repair that has taken place in the bones and soft textures of the spine, and the disintegration resulting from the injury of the cord. From a spare man, forty-eight years of age, who fell backwards for a distance of six feet off a scaffold on his shoulders. A well-marked displacement between the seventh and eighth dorsal vertebræ was observable on his admission into the hospital, the seventh with the bones above being carried forwards, and a depressed groove from the fourth to the broken seventh spinous process being manifest. The superior articular processes of the eighth could be felt. The ordinary symptoms of lesion of the corresponding part of the spinal cord were present. The patient under chloroform was subjected to extension by means of pulleys with the result of replacing the bones in their normal position, the distortion being entirely removed. He died, however, from exhaustion consequent on the paralysis at the end of nine weeks from the receipt of the injury.

IV. 63.—Lower dorsal and upper lumbar portions of a spine, from a man twenty-nine years of age, who, whilst wheeling a barrow filled with gravel, was knocked down by the sudden falling of a tree on his back. (He lived for more than a year after the injury.) When examined soon after the injury an angular projection was discovered in the lumbar region and extension was made by persons pulling at the superior and inferior extremities with the desired effect of greatly lessening the projection.

The specimen shows that the first lumbar vertebra had been fractured in a transverse direction extending obliquely downwards and forwards through the upper third of its body; the upper part of the vertebral column together with the upper fragment of the fractured vertebra had been thrown forwards, the superior fragment resting on the fore and upper part of the inferior fragment, to which it is connected by callus. The corresponding articular processes of the last dorsal and first lumbar vertebræ had been dislocated, those of the former having been thrown upwards and forwards.

COMPRESSION OF THE CORD RELIEVED BY OPERATION.

IV. 54.—The lower cervical and upper dorsal vertebra of a man who fell down a ship's hold and fractured his spine. The fracture extended obliquely through the fourth dorsal vertebra and the intervertebral cartilage above. The spines of the injured and adjoining vertebræ were removed by operation with relief of the symptoms of compression of the cord. On the fifteenth day after the operation, while the man was being removed from one bed to another, the spine not being supported, he became suddenly and completely paraplegic, and died three or four days after. Opposite the fracture the cord was diffuent.

Fracture of the Vertebral Column.

FIGURE 1. *Fracture of the vertebral column.* There has been a comminuted fracture of the body of the fifth cervical vertebra. A fragment of the body has been driven backward into the vertebral canal, completely compressing the spinal cord. A curved instrument is shown in front of the spine above the fracture, and the fragments are being drawn together.

The patient is lying on a table, and the head is being held steady by the injury.

The patient is lying on a table, and the head is being held steady by the injury.

Dislocation of the Spine.

Dislocation of the spine is nearly always associated with fracture of the articular processes. It occasionally occurs, however, in the cervical region without being accompanied by fracture, and is said to have occurred in the dorsal and lumbar portions of the spine. In which the articular processes are interlocked in these regions it is difficult to conceive how dislocation without some amount of fracture is possible.

Dislocation is nearly always incomplete. The vertebra is never displaced singly, the vertebra above being always carried along with it. The intervertebral cartilages and surrounding ligaments are never torn. The spinal cord may be ruptured, or it may be completely crushed in some cases at the seat of injury. The spinal nerves may be compressed in some as they pass through the intervertebral foramina.

I. Dislocation in Cervical Region.

Of atlas from axis.

Dislocation of the atlas from the axis is rare. It is accompanied either by fracture of the odontoid process or by rupture of the transverse ligament, and is generally immediately fatal, the atlas along with the occipital bone slipping forward upon the axis, and crushing the upper part of the spinal cord. This is not invariably the result, however, as in the following model the cord is said to have been uninjured.

Dislocation of the occipital bone from the atlas is so rare that it may be left out of consideration.

IV. 50.—Model of an atlas and axis. The atlas is dislocated and the odontoid process fractured. The spinal cord was not injured.

Of lower five cervical vertebrae.

Unaccompanied by fracture of the articular processes.—IV. 8.—Portion

of a spine, in which there is complete dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ, without any fracture.

IV. 12.—Sections of a spine in which there is a complete dislocation of the bodies and articular processes of the fourth and fifth cervical vertebræ without any fracture. The fourth vertebra is carried forwards, so that the posterior margin of its body rests on the anterior margin of the body of the fifth, and the apex of its spinous process rests on the base of the spinous process of the fifth.

The patient, a robust man twenty-two years old, fell with a heavy weight on his head and upper part of his neck. He was immediately deprived of all sensibility in the trunk and limbs, and of all power over the voluntary muscles of those parts. He died three days and a half after the fall.

IV. 13.—Portion of a spine, in which there is a complete dislocation of the articular processes of the sixth and seventh cervical vertebræ, and a partial dislocation of their bodies, without any fracture. The right half of the intervertebral cartilage is torn through; the left half is nearly entire. The articular processes of the sixth vertebra were raised up above those of the seventh, but had not passed to the front of them,

The patient fell, from a height of about sixteen feet, on his head, and his neck was bent by the weight of his body. He lost all sensibility and power of voluntary motion in the trunk and limbs, and died on the third day after the fall.

Accompanied by fracture of the articular processes.—IV. 3. Portion of a spine, in which there is dislocation of the articular processes of the fourth and fifth cervical vertebræ, with fracture of the lower edge of the left inferior articular process of the fourth, and a separation of the intervertebral cartilages uniting the bodies of the fourth and fifth, and of the fifth and sixth.

IV. 10.—Portion of a spine in which there is dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ with fracture of the articular processes of the fifth. The articular processes of the fifth are raised up from those of the sixth, but have not passed to the front of them. The posterior part of the intervertebral cartilage appears to have been deeply torn.

IV. 2. Portion of a spine, in which the articular processes of the fifth and sixth cervical vertebræ are dislocated, and the right articular process and body of the sixth are broken. The intervertebral cartilage between the fifth and sixth vertebræ is also completely torn across. The spinal cord has been divided along its middle for the purpose of showing the softening and laceration of its substance opposite the injured vertebræ, and especially in the line opposite the division of the intervertebral cartilage.

IV. 11.—Portion of a spine, in which there is dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ, with fracture of the sixth. The right inferior articular process of the fifth has passed to the front of the right superior process of the sixth; the

REPAIR AFTER FRACTURE.

Sub-series D. 5. Section of a spine. There has been a comminuted fracture of the body of the first lumbar vertebra. A fragment of the body has been pushed backwards into the vertebral canal, completely obliterating it. Some new bone is formed in front of the spine above and below the fracture, and holds the adjacent vertebræ together.

The patient, an adult, lived about three months after the injury. There was no paralysis of the lower limbs.

The cauda equina, as is common, has in this case escaped.

DISLOCATION OF THE SPINE.

Dislocation of the spine is nearly always associated with fracture of the articular processes. It occasionally occurs, however, in the cervical region entirely unaccompanied by fracture, and is said to have occurred in the dorsal and lumbar, but from the manner in which the articular processes are interlocked in these regions it is difficult to conceive how dislocation without some amount of fracture is possible.

Dislocation is nearly always incomplete. One vertebra is never displaced singly, the vertebræ above being always carried along with it. The interarticular cartilages and connecting ligaments are more or less torn. The spinal cord may be uninjured, or it may be completely crushed or torn across at the seat of injury. The spinal nerves may be compressed or torn as they pass through the intervertebral notches.

I. DISLOCATION IN CERVICAL REGION.

Of atlas from axis.

Dislocation of the atlas from the axis is rare. It is accompanied either by fracture of the odontoid process or by rupture of the transverse ligament, and is generally immediately fatal, the atlas along with the occipital bone slipping forward upon the axis, and crushing the upper part of the spinal cord. This is not invariably the result, however, as in the following model the cord is said to have been uninjured.

Dislocation of the occipital bone from the atlas is so rare that it may be left out of consideration.

IV. 50.—Model of an atlas and axis. The atlas is dislocated and the odontoid process fractured. The spinal cord was not injured.

Of lower five cervical vertebræ.

Unaccompanied by fracture of the articular processes.—IV. 8.—Portion

of a spine, in which there is complete dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ, without any fracture.

IV. 12.—Sections of a spine in which there is a complete dislocation of the bodies and articular processes of the fourth and fifth cervical vertebræ without any fracture. The fourth vertebra is carried forwards, so that the posterior margin of its body rests on the anterior margin of the body of the fifth, and the apex of its spinous process rests on the base of the spinous process of the fifth.

The patient, a robust man twenty-two years old, fell with a heavy weight on his head and upper part of his neck. He was immediately deprived of all sensibility in the trunk and limbs, and of all power over the voluntary muscles of those parts. He died three days and a half after the fall.

IV. 13.—Portion of a spine, in which there is a complete dislocation of the articular processes of the sixth and seventh cervical vertebræ, and a partial dislocation of their bodies, without any fracture. The right half of the intervertebral cartilage is torn through; the left half is nearly entire. The articular processes of the sixth vertebra were raised up above those of the seventh, but had not passed to the front of them,

The patient fell, from a height of about sixteen feet, on his head, and his neck was bent by the weight of his body. He lost all sensibility and power of voluntary motion in the trunk and limbs, and died on the third day after the fall.

Accompanied by fracture of the articular processes.—IV. 3. Portion of a spine, in which there is dislocation of the articular processes of the fourth and fifth cervical vertebræ, with fracture of the lower edge of the left inferior articular process of the fourth, and a separation of the intervertebral cartilages uniting the bodies of the fourth and fifth, and of the fifth and sixth.

IV. 10.—Portion of a spine in which there is dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ with fracture of the articular processes of the fifth. The articular processes of the fifth are raised up from those of the sixth, but have not passed to the front of them. The posterior part of the intervertebral cartilage appears to have been deeply torn.

IV. 2. Portion of a spine, in which the articular processes of the fifth and sixth cervical vertebræ are dislocated, and the right articular process and body of the sixth are broken. The intervertebral cartilage between the fifth and sixth vertebræ is also completely torn across. The spinal cord has been divided along its middle for the purpose of showing the softening and laceration of its substance opposite the injured vertebræ, and especially in the line opposite the division of the intervertebral cartilage.

IV. 11.—Portion of a spine, in which there is dislocation of the bodies and articular processes of the fifth and sixth cervical vertebræ, with fracture of the sixth. The right inferior articular process of the fifth has passed to the front of the right superior process of the sixth; the

corresponding processes on the left side more nearly retain their places, so that the upper part of the spine is twisted round towards the left side.

IV. 5.—Portion of a spine, in which there is dislocation, with fracture of the edges of the articular processes, of the sixth and seventh cervical vertebræ. The body of the sixth cervical vertebra is separated from the intervertebral cartilage below it, and projects in front of the seventh.

II. DISLOCATION IN DORSI-LUMBAR REGION.

Accompanied by fracture of the articular processes. Sub-series D. 4.—Sections of a spine, in which it is probable that there had been a fracture and dislocation of the first lumbar and the last dorsal vertebræ. The first lumbar vertebra, unchanged in texture, but deprived of the fore part of the upper margin of its body, is thrown backwards, so that its fractured anterior margin is placed under the posterior margin of the body of the twelfth dorsal vertebra. They appear as if the last dorsal vertebra, with the superior portion of the spine, had been pushed forwards and downwards, breaking off and sliding over the upper and anterior margin of the first lumbar. In this position the two vertebræ are firmly fixed by bone deposited in front of the angle formed by their bodies. At the angle thus formed the body of the first lumbar vertebra projects into the spinal canal, reducing it to a fourth of its natural diameter. A distance of an inch intervenes between the spinous processes of the last dorsal and the first lumbar vertebræ. On the right side their corresponding articular surfaces appear to have been separated and re-united by bone; on the left side the inferior articular process of the last dorsal vertebra is wanting, but there are appearances as if it had been united to the posterior part of the body of the displaced first lumbar vertebra: it was probably detached in the dissection.

MALFORMATIONS OF THE SPINE.

SPINA BIFIDA.

Spina bifida is a swelling in the middle line of the back, formed by the protrusion of the spinal membranes through a congenital fissure in the spines of one or more vertebræ, the result of an arrest of development of the neural arches.

It may occur at any part of the spine, but is most common in the lumbo-sacral region; by Henfry it is said to occur with the greatest frequency at the first sacral vertebra, whose neural arches, as he remarks, are the latest to unite. It is frequently associated with other malformations of the neural canal, especially with meningocele and with hydrocephalus.

A spina bifida may be said to consist of a sac and its contents.

The sac, composed of the protruded membranes intimately blended together, is distended by a collection of fluid, and generally contains either the spinal cord or some large nerve-roots. The membranes protruded are either the dura mater and visceral and parietal layers of the arachnoid, or the dura mater and parietal layer of the arachnoid only. In the former case, which is by far the more common, the cavity of the sac communicates with the subarachnoid space, and contains cerebro-spinal fluid; in the latter case it communicates with the cavity of the arachnoid, and contains a fluid similar to that normally found in the arachnoid cavity.

The relation which the spinal cord or cauda equina, as the case may be, bears to the sac varies; in rare cases the cord appears spread out as a thin membrane lining the sac, a condition probably due to the distension of its central canal with fluid; in other cases the spinal cord or cauda equina passes into the sac, and is connected with its walls in the middle line, or "a variable number of large nerves are connected to the sac, of which those which would naturally correspond to the vertebræ implicated in the tumour pass through the membranes to their distribution, while the lower ones return into the spinal canal. Finally, only a few nerves may be found supplied to the sac and its envelopes, or no trace of nerves may be discovered" (Holmes).

According to Mr. Prescott Hewett, the cord or cauda equina is always found in the sac when the fluid has collected in the subarachnoid space, but remains in the spinal canal when the fluid has collected in the arachnoid cavity.

The tumour is oval or globular in shape, with its long axis parallel to that of the spine. It is commonly covered by skin and adipose tissue, but in some instances the skin is adherent to the sac, and forms with it a thin translucent membrane.

Series A. 127.—Spina bifida, with defective formation of the laminae, or arches, of the lower lumbar and the sacral vertebræ. A sac is formed by the protrusion of the membranes of the spinal cord. The cavities of the sac and of the spinal canal are shown by lateral section, and their continuity is marked by bristles passed through their narrow aperture of communication. Two large nerve-roots appear to have protruded with the sac of dura mater, and are adherent to its posterior walls.

Series A. 128.—A similar specimen, with the sac open from behind. Several nerve-roots pass out from the spinal canal, and are adherent to the inner surface of the sac.

Series A. 129.—A similar specimen of sacral spina bifida, from a child about six years old. The spinal canal and sac are laid open from behind, showing the passage of some of the sacral nerve-roots from the cord into the sac. The spinal cord reaches to the last lumbar vertebra.

Series A. 130. A similar specimen. The spinal cord extends into the sacral portion of the canal.

Series A. 133.—Dorsal and lumbar portions of a fetal spine. The spinal canal is wide open behind, the laminae or neurapophyses of nearly all the vertebrae being disparted and turned outwards. They are not deficient in size; rather, they are overgrown and expanded at their distal ends.

Series A. 189.—Part of the wall of a lumbar spina bifida. The nerves having been dissected out are seen spread out over its inner surface.

Series A. 196.—The spinal column of an infant at the period of birth; from a case of spina bifida.

Series A. 132. A sacrum, in the whole length of which the spinal canal is wide open behind, through defective formation of the laminae or neurapophyses.

Series A. 134. Part of a fetal skeleton; from a case of hydrocephalus with spina bifida. Except those of the three dorsal and two cervical vertebrae, all the laminae are deformed and disparted, like those in the preceding specimen. The occipital bone also appears to have been similarly defective.

Series A. 228.—A spina bifida. The sac communicates with the cavity of the arachnoid. There were not any nerves in the sac.

Series A. 220.—The sac of a spina bifida that was excised.

CHAPTER VII.

INJURIES AND DISEASES OF THE SKULL AND BRAIN.

FRACTURES OF THE SKULL.

THESE may be divided into fractures of the vault and fractures of the base.

FRACTURES OF THE VAULT.

Fractures of the vault are commonly the result of direct violence, such as a severe blow or fall upon the head. The fracture may take the form of a simple fissure, uncomplicated by any displacement of bone, extending for a variable distance over the vault, even to the base, or of several fissures radiating from a central depressed portion of bone (starred or punctured fracture). Again, the skull at the seat of injury may be broken into several pieces (comminuted fracture), or a portion of bone may be pressed inwards (depressed fracture), or in rare instances elevated above the level of the skull.

The fracture may be limited either to the outer or to the inner table; but it more often involves the whole thickness of the skull, in which case the injury of the inner table is generally more extensive than that of the outer. Any of the above varieties may be accompanied by a wound of the integuments leading to the seat of fracture (compound fracture), or by laceration or other injury of the brain and its membranes. Injury of the brain is especially common in punctured fractures.

III. 83.—Section of a skull-cap, exhibiting a fracture extending in several directions through the anterior part of the parietal bones. In one situation there is a fracture of the outer, without any corresponding fracture of the inner, table.

III. 84.—Section of a skull-cap, exhibiting a comminuted circumscribed fracture of the outer and inner tables of one of the parietal bones. Many pieces of the inner table are depressed.

During life the outer table was raised by the elevator, and it was

supposed that the instrument was acting upon the whole thickness of the skull, whereas the fragments of the inner table remained unmoved.

Sub-series C. 129.—Vertex of a skull, showing an extensive comminuted fracture of the parietal bones, and, to a less extent, of the frontal. The displaced portion of the parietal pressing downwards and acting like a wedge, has caused separation of the sutures in the immediate vicinity.

The fracture occurred three weeks before death, and scanty new bone may be seen deposited about the edges of the displaced portions, chiefly on the cerebral surface.

III. 116.—Portion of the parietal bone of a child, on which a sharp piece of a chimney-pot fell from a house-roof. It made a circular aperture in the skull, half an inch in diameter, and forced the bone which was included within this circle into the brain and dura mater. Portions of the bone thus driven in remain attached to the margins of the aperture.

The child remained for three weeks with scarcely any of the usual symptoms of injury of the brain. Inflammation of the brain then ensued, and soon ended fatally.

III. 144.—Posterior portion of a right parietal bone of a boy, aged three years, showing a compound depressed fracture of the skull. Death ensued from meningitis.

FRACTURE OF THE BASE.

Fracture of the base of the skull is commonly caused by indirect violence, such as a severe blow, a fall from a height upon the head, or, more rarely, from a fall upon the feet or nates, in which case the fracture is produced by the shock transmitted to the occipital bone through the spine.

Fracture of the base may also be caused by direct violence, such as a sword thrust through the roof of the orbit, &c.

When produced by a blow or fall upon the vault, the fracture through the base is generally but the extension of a fissure starting from the part struck. Hence, as a rule, the anterior, middle, or posterior fossa is found fractured, according as the blow falls upon the anterior, middle, or posterior part of the vault. Should the force, however, be very severe, fissures may radiate from the seat of injury to two, or even to all three fossæ.

Fractures through the middle fossa generally involve the petrous portion of the temporal bone on one or both sides of the skull. They frequently extend through the internal and external auditory meatus and walls of the tympanum, lacerating the prolongation of dura mater contained in the internal auditory meatus, the reflexion of the arachnoid around the seventh pair of nerves, and the membrana tympani, and so allowing of the escape of the cerebro-spinal fluid from the external auditory meatus.

The fracture may also involve the lateral sinus or middle meningeal artery, in which case blood may be found mixed with the cerebro-spinal fluid that escapes from the ear.

Fracture of the anterior fossa generally extends through the roof of the orbit and nose, allowing the escape of cerebro-spinal fluid and blood from the nostrils.

Fracture through the posterior fossa extends through the occipital bone, and frequently through the petrous portion of the temporal bones.

One or more of the nerves which escape through the bony foramina in the base of the skull, the lateral sinus, the middle meningeal artery, or one of the smaller blood channels, are frequently torn or otherwise injured in fracture of the base.

III. 130.—The petrous portion of a temporal bone, removed from the base of a skull which was fractured.

Sub-series C. 134.—Portion of the occipital, of the left temporal, and parietal bones, showing the course of a fracture which extended, without laceration of the dura mater, from the foramen magnum, ascending on the one hand through the groove for the lateral sinus, and thence towards the parietal bone, and on the other passing through the petrous portion of the temporal, across the outer extremity of the external auditory meatus, through the vestibule and tympanum, and so downwards, lacerating the membrana tympani.

The patient died with ordinary symptoms of fracture of the base of the skull.

III. 137.—The right occipital portion of the posterior fossa of the base of the skull, from a girl, aged nine years, showing a circular depressed fracture the size of a shilling. The outer table, though depressed, is entire; the inner table is crushed in three or four directions.

Sub-series C. 143.—Portion of the right side of the base of the skull, with a fracture extending across the mastoid and petrous portions of the temporal bone. The inner portion of the petrous bone is almost separated from the outer by the fracture. Colourless fluid had escaped from the ear during life. From a boy, aged eleven, who died five days after being run over by a heavy van.

Sub-series C. 144.—Fissured fracture of the skull, from a child, aged four years, who fell from a window in the first floor of a house. The right parietal bone is traversed by two converging fissures united by a transverse fissure. There is no depression of the fragments. At the base of the skull two fissures extend from either side of the foramen magnum into the corresponding temporal fossæ. These fissures did not unite with those seen on the vertex, and were probably produced by the weight of the body being suddenly thrown on the occipital condyles, through the cervical spine, when the vertex struck the ground.

The child died comatose about three hours after the accident.

PROCESS OF REPAIR AFTER FRACTURE OF THE SKULL.

In fracture of the vault, unaccompanied by displacement or loss of substance, repair is accomplished by intermediate callus, either entirely without or with a very slight production of provisional callus. In fractures where portions of the whole thickness of the bone have been removed the aperture remains, the bones around become smooth and rounded off, the exposed diploë covered in by compact bone, and the dura mater adheres to the scalp, forming a fibrous cicatrix for the protection of the brain. Sometimes, however, as in the case of two of the following specimens, the hole is partially closed by the formation of new bone, the bone being produced from the margin of the aperture, not from the dura mater or pericranium.

In fractures through the base union may be effected by fibrous tissue or by bone, with or without the production of provisional callus; in some cases no union has occurred.

Sub-series C. 140.—Two portions of the frontal bone of a man, aged thirty-seven, who, nine months before his death, fell off a van and injured his head. On the external table, in front of the coronal suture, is seen a depressed line like a cut. Over a considerable extent of the inner surface of both portions new bone is deposited.

III. 38.—Portion of a skull, in which an extensive fracture of the adjacent parts of the occipital and parietal bones occurred four years before death. Some portions of bone, detached by the fracture, were removed at the time of the accident; other portions were left, and have been reunited by bone. There is also a close union by bone of two lines of fracture extending outwards through the parietal bones. The margins of all the broken portions of bone have been smoothly rounded, and their exposed diploë is covered in by compact bone.

III. 63.—A skull-cap, in which fracture with loss of bone was produced by the wheel of a cart passing over the head several years before death. The frontal and right parietal bones were broken into many pieces, and the sagittal and coronal sutures were separated. Several portions of bone, which were insulated by the fracture, were removed, leaving numerous and considerable apertures in the skull; other insulated portions are thinned by absorption, but their edges are reunited by osseous substance. Considerable thickening of the frontal bone has taken place in one situation contiguous to the fracture. No new bone appears to have been formed in the spaces left after the removal of the loose fragments.

III. 109.—Portions of a skull, in which a trephine hole, made thirty-four years before death, has been nearly filled up by new bone. The greater part of the new bone has been produced from the border of the aperture in the inner table. The aperture still remaining is of an irregularly oval form, about five inches long and a line and a half wide.

Its margins are sharp, and its borders shelve obliquely inwards and downwards from the surrounding healthy bone. It was filled up by a tough fibrous membrane.

The patient, a sergeant of marines, was struck on the head with a tomahawk, at the taking of the Danish fleet in 1807, and was trephined in Haslar Hospital shortly afterwards by Sir Stephen Hammick.

III. 93.—Portions of the crania of two young dogs, upon whom the operation of the trephine was performed two months before they were killed. The piece of card indicates the size of the trephine which was employed. In each instance the opening is narrowed and altered in figure. The deposit of osseous matter has taken place wholly from the edges of the opening in the bone, and in no degree from the pericranium or dura mater.

The experiment was performed by Mr. Stanley.

EFFUSION OF BLOOD.

Effusion of blood following injuries to the head may occur either inside the skull, or outside, in the substance of the soft tissues forming the scalp. There are no specimens in the Museum of effusions of blood outside the skull.

EFFUSIONS OF BLOOD INSIDE THE SKULL.

The effusion may be situated—(1) between the bone and dura mater, (2) between the layers of the arachnoid, (3) in the pia mater, or (4) in the substance of the brain itself.

1. *Between the skull and dura mater.*

Effusions of blood in this situation generally proceed from the middle meningeal artery or from the lateral sinus; occasionally from the small vessels running between the dura mater and bone. These effusions are generally considerable, widely separating the dura mater from the bone, and producing a deep depression upon the surface of the brain. The blood generally coagulates into a very firm clot which may either be absorbed, or undergo organisation and become adherent to both the bone and the dura mater. It may even undergo ossification, but, unlike clots in the cavity of the arachnoid, never becomes encysted.

VI. 39.—A large clot of blood between the dura mater and the lateral part of a skull.

The blood was effused from the middle meningeal artery, which was ruptured by external violence.

VI. 71.—Part of a parietal bone of an infant, with an effusion of blood between the skull and dura mater. The blood forms a circumscribed oval layer, about half an inch thick, and is coagulated. Thin

plates of porous new bone have been formed in the dura mater around part of the margin elevated by the effused blood, as well as in distinct patches nearer to the centre of the part thus elevated. A small quantity of new bone is also formed on the inner surface of the skull near the margin of the effused blood, but there is no appearance of any being formed beneath the blood.

2. *Between the layers of the arachnoid.*

Effusions of blood into the cavity of the arachnoid, especially in that part which covers the cerebrum, are very frequent; they are the result of capillary rupture, and follow upon most cases of severe injuries of the head.

The effused blood, which from the first is evenly spread in a thin layer over the surface of the cerebrum, rapidly clots, loses its colouring matter, undergoes organisation, and assumes the form of a false membrane or of a membranous cyst. The false membrane may be delicate and film-like, or thick and leathery, according to the quantity of blood effused; it has a smooth, polished internal surface, and is nearly always adherent to the parietal layer of the arachnoid from which it receives its blood supply. The cysts are formed by the organisation of the outer part of the clot, whilst the central portion remains as fluid or clotted blood; like the membranes, they are, for the most part, firmly adherent to the parietal arachnoid, but have been found free in the arachnoid cavity. After they have existed some time the blood in their interior becomes absorbed, and they take on a secreting action like other cysts. They have been found containing a serous fluid.

Clot in the arachnoid cavity. VI. 38.—A large clot of blood in the cavity of the arachnoid adhering to the parietal layer, consequent upon external injury.

Blood membranes in arachnoid cavity. VI. 1.—Portion of dura mater, exhibiting a newly formed membrane upon its internal surface, *i. e.* upon the inner surface of the parietal layer of the arachnoid. This membrane lines the whole of the dura mater covering the right hemisphere of the cerebrum; its thickness is about equal to that of the peritoneum, and it is very vascular throughout; it has been completely separated from the dura mater, except along one edge, where it is still adherent; and it will be observed that this edge is insensibly lost upon the dura mater, so that the internal surface of the new membrane, and that of the dura mater, appear to be continuous. The outer surface of the membrane is rust-coloured, like partially decolorized blood. Towards its lower part the new membrane is thicker than above, and it is here divisible into two distinct layers. The arachnoid beneath this layer of membrane is thickened.

VI. 2 and 3.—Similar specimens.

It was formerly believed that specimens like the above were examples of effusion of blood between the dura mater and parietal layer of the arachnoid. "The blood glued to the parietal layer of the arachnoid and covered over by a thin polished serous-like membrane (the blood membrane), looks," says Mr. Prescott Hewett, "exactly as if the extravasation had taken place between the dura mater and its arachnoid, and widely separated these membranes from each other."

Blood cysts in arachnoid cavity. VI. 45.—Portion of dura mater, exhibiting a newly-formed, thin, and nearly transparent membrane, closely adherent to its internal surface, and consisting of two layers, which form a large cyst containing coagulated blood.

VI. 52.—Portion of dura mater, upon the internal surface of which there is an adventitious membrane in the form of a cyst which was filled by coagulated blood. The membrane is of a dense texture, and of about the thickness of the dura mater. Portions of the blood still remain attached to the inner walls of the cyst.

3. *Into the pia mater.*

Effusions of blood in the pia mater, that is, between the visceral layer of the arachnoid and pia mater, are far less common than those in the cavity of the arachnoid. They are generally associated with some injury of the brain itself and are very extensive, spreading far and wide in the spaces normally occupied by the cerebro-spinal fluid. The blood does not become organised as in other situations.

VI. 15.—Portion of cerebrum, with an extensive effusion of blood upon its surface between the arachnoid and pia mater.

4. *Into the brain substance.*

Traumatic effusions of blood into the brain substance may occur in any situation; they are generally associated with extensive laceration or other severe injury of the brain, and are, for the most part, fatal. Should recovery, however, take place, the clot of blood undergoes similar changes to those observed in the organisation of an ordinary apoplectic clot.

VI. 25.—Portions of a brain, exhibiting deep laceration of its substance, with effusion of blood in the interior and in one of the middle lobes of the cerebrum, and in both lobes of the cerebellum. From a woman who fell down stairs upon her occiput.

CONTUSIONS AND LACERATIONS OF THE BRAIN.

Contusions and lacerations may occur in any part of the brain, but are most frequent at the base. As these injuries are but poorly illustrated in the Museum they will not receive further notice.

VI. 36.—Portions of cerebrum, exhibiting circumscribed bruising with loss of substance and effusion of small quantities of blood in its convolutions, the consequence of external injury.

VI. 25.—Portions of brain, exhibiting deep lacerations of its substance, with effusions of blood in the anterior and in one of the middle lobes of the cerebrum, and in both hemispheres of the cerebellum.

From a woman who fell down stairs upon her occiput. She was immediately insensible, and died on the fifth day, with signs of acute inflammation of the brain. A fracture was found extending from the transverse ridge of the occipital bone through several portions of the petrous part of the temporal bone.

INFLAMMATION OF THE BRAIN AND ITS MEMBRANES.

Traumatic inflammation of the brain and its membranes may occur after almost any injury of the head, but more especially after injuries of the cranial bones and lacerations and contusions of the brain-substance itself.

The inflammation may begin in the membranes of the brain (meningitis), or in the substance of the brain itself (encephalitis). It seldom, however, remains long limited to either of these structures, but sooner or later involves both.

MENINGITIS.

Traumatic inflammation of the membranes of the brain may begin either in the dura mater, when it is commonly the result of some injury of the bone or scalp, or in the pia mater, when it is generally consequent upon inflammation of the brain itself. When inflammation begins in the dura mater it generally spreads inwards, involving membrane after membrane, and finally the brain itself. When it begins in the pia mater it seldom, except in severe cases, spreads beyond this membrane.

The various appearances presented by the dura mater, arachnoid, and pia mater, as they are successively attacked by inspreding inflammation, may next be studied in detail.

Dura mater and parietal arachnoid.

The inflammation is at first confined to the outer surface of the dura mater, and to that portion only which lies immediately under the injured bone. The affected part appears red, injected, and covered by inflammatory products. The inflammation afterwards involves the whole thickness of the dura mater, and consequently the parietal layer of the arachnoid, which constitutes its inner surface, and spreads far and wide over the free surface of the parietal arachnoid. In very severe cases the dura mater may slough. In

chronic cases the dura mater becomes infiltrated, thickened, and very adherent to the bone.

Inflammation limited to external surface of dura mater. VI. 4.—Portions of dura mater and pia mater. Blood and inflammatory products are copiously effused upon the external surface of the dura mater. These changes were consequent upon an external injury.

Inflammation of the whole thickness. VI. 7.—Portions of dura mater. Both surfaces are covered with inflammatory material.

Sloughing of dura mater. VI. 78.—Portions of dura mater. About its centre is a considerable portion, soft and flocculent on the surface next to the bone. When recent it was of a brownish colour. The whole of the discoloured part seemed to be in a sloughing condition.

Thickening of dura mater. VI. 5.—The dura mater in this specimen is thickened and indurated, measuring from a line to a line and a half in thickness. It has a tough, laminated texture.

VI. 63.—The dura mater is greatly thickened, in some situations measuring half an inch in thickness, and appears tough and laminated.

From a man who, eleven years before death, received a violent blow upon the head, which was supposed to have fractured his skull.

Visceral layer of the arachnoid and pia mater.

The inflammation having reached the parietal layer of the arachnoid now spreads to the visceral layer, and from thence to the pia mater, while the cavity of the arachnoid generally becomes filled with greenish-yellow inflammatory material, and often with pus, although, in some instances, the effusion is limited by adhesions occurring between the two layers. Similar inflammatory material is produced on the surface of the pia mater and extends with that membrane between the convolutions over the whole surface of the affected hemisphere, and sometimes even over that of the opposite side. The pia mater itself becomes opaque, thickened, infiltrated, and indurated, so that when it is removed its prolongations, which dip between the convolutions, can be pulled out without tearing, which cannot be done in the healthy brain.

VI. 78.—The visceral arachnoid in this specimen is slightly inflamed.

VI. 4.—The pia mater in this specimen is thickened, opaque, and indurated, both in that part which covers the convolution and in that which penetrates between them.

ENCEPHALITIS.

Inflammation of the brain may follow inflammation of its membranes, in which case usually the cortical substance only is affected; or it may be the result of contusion or laceration of the brain-substance itself, when both the cortical layer and the white matter

around the seat of injury are equally involved. In the former case the cortical layer, which is very adherent to the inflamed pia mater, appears brownish-red, swelled, soft, and diffuent, so that it can be washed away by a gentle stream of water poured upon it. The white substance presents more puncta than usual, but is otherwise but little affected. The ventricles are frequently distended with serous fluid.

VI. 36.—Portion of a cerebrum, exhibiting a circumscribed softening, following an external injury.

When the inflammation is consequent upon laceration or contusion of the brain-substance, both the cortical and white substance immediately around the seat of injury become intensely congested, dull red, soft, and diffuent, and finally break down into pus, giving rise to a cerebral abscess.

VI. 47.—Portion of a cerebrum, exhibiting an abscess on the upper part of one of its hemispheres, with the dura mater which covered it. The abscess communicates with the lateral ventricle by the aperture through which a bristle is passed. The internal surface of the abscess is rough, and that of the ventricle is lined by inflammatory products. Inflammatory material is also deposited upon the dura mater, and there is an ulcerated aperture in it, which communicated with the cavity of the abscess and through which a bristle is passed.

The patient, a child four years old, had an extensive scalp-wound of the right side, followed by suppuration, sloughing, and exposure of the cranium. A month after the injury was received, and while all seemed proceeding favorably, the child was seized with convulsions, which were followed by partial paralysis and insensibility. By the trephine a small quantity of matter was let out from between the skull and dura mater, but without relief; and the child died three days after the convulsions begun.

VI. 29.—Portion of a cerebrum, in the left hemisphere of which there is an abscess an inch and a half in diameter, which contained pus. The abscess is situated immediately over the fissura Sylvii; its walls are distinct, thin, smooth on both surfaces, and easily separable from the surrounding surface of the brain.

The patient had purulent discharge from the left ear for five weeks before his death. He died suddenly. The petrous portion of the temporal bone, over which this encysted abscess was situated, was extensively diseased. The portion of brain between the abscess and the bone was dark and sloughy.

HERNIA CEREBRI.

Hernia cerebri is a protrusion of brain-substance through a hole in the cranial bones and dura mater. It may occur after any injury

to the cranium accompanied by loss of bone and by a wound or slough of the dura mater. It is most common after compound fracture or the application of the trephine. The protrusion is the result of a swelling of the brain from inflammation, and generally occurs three or four days after the injury to the cranium. It must be distinguished from the mere escape of brain-substance which occasionally occurs at the time of injury.

Hernia cerebri appears as a reddish-brown, blood-stained, fungus-looking mass, overhanging the hole in the cranium through which it has escaped, and pulsating synchronously with the brain. On section it is seen to consist of brain-substance infiltrated with inflammatory products and covered by granulations and blood-stained pus.

The protrusion generally increases continuously, and may attain the size of an orange. Sometimes, however, it becomes constricted at its base and sloughs away, the parts cicatrize, and the patient recovers; or after its removal, either by sloughing or by other means, fresh protrusions of brain-substance take its place and the patient dies comatose. At other times the interior of the mass breaks down into an abscess, or its vessels give way and extensive hæmorrhage results.

Hernia cerebri is said to occur more frequently when the hole in the cranium is small than when the hole is large; to be more common after injuries of the anterior part than after injuries of the posterior; and to occur more often in the young than in the old.

Protrusions, similar in outward appearance to the above, composed either of granulation-tissue springing from the surface of the inflamed brain or of coagulated blood, sometimes occur, and are often described as varieties of hernia cerebri.

VI. 23.—Several large portions of cerebrum, which protruded in a case of hernia cerebri, and were removed during life.

The patient was a boy twelve years old. He had fracture with depression about the lambdoidal suture. Portions of bone were removed without injury of the dura mater; and on the tenth day after the fracture the hernia of the brain appeared, and in three days was as large as an orange. He died on the third day after the removal of these portions of brain, in which, when first removed, both the cortical and medullary substance presented a natural appearance.

VI. 32.—Portions of brain, skull, and cerebral membranes, exhibiting a hernia cerebri. The front of the preparation shows a vertical section of the protrusion and of the part of the brain from which it has arisen. In the centre of the protruded brain, which consists of medullary substance, the vessels have given way and blood is effused in it. The portions of the skull and of the membranes of the brain surrounding the base of the protrusion were included in the section, for the purpose

of showing how the protrusion has taken place through the openings formed by ulceration in the dura mater and pia mater, and through the aperture in the bone.

VI. 33.—Section of the protruded brain last described. The deep groove which intervenes between the outer part of the protruded mass and the portion of brain from which it has arisen, was occupied by the bone and by the membranes of the brain.

The patient, a boy thirteen years old, had extensive fracture of the frontal bone, and several portions of bone were removed without injury of the dura mater. The protrusion of the brain began on the fifth day after the injury, and increased, without disturbance of the intellect or other remarkable symptoms, till the tenth day, when the protruded mass, consisting of healthy cortical and medullary substance, was cut off. For the next ten days the protrusion was restrained by firm pressure; but, insensibility ensuing, the pressure was discontinued; the protrusion at once again made progress, and the patient died on the twenty-seventh day after receiving the injury, with softening of the brain.

VI. 34.—Portions of cerebrum, which protruded in a case of hernia cerebri, and were removed during life.

The patient, a boy eleven years old, had fracture of the frontal bone, several portions of which were removed, without injury to the dura mater. The protrusion began on the seventh day; it was twice removed, and as often reproduced; but the portion last protruded sloughed off, and the patient completely recovered.

VI. 84.—Portion of a brain and its membranes and of the right frontal bone of a boy aged eight, who four months before his death sustained a compound fracture of the right frontal bone. A fortnight after the accident a portion of the brain began to protrude, which gradually increased until his death. From time to time serum and pus were let out from the wound with considerable relief to the cerebral symptoms. A considerable portion of cerebral substance protrudes beyond the integuments, and the section shows its continuity with the rest of the brain. Beneath the adjacent portion of dura mater is a large cavity which was filled with pus.

CONGENITAL MALFORMATIONS OF THE CRANIUM.

MENINGOCELE AND ENCEPHALOCELE.

A meningocele is a tumour formed by the protrusion of the membranes of the brain through a congenital aperture in the skull, and containing cerebro-spinal fluid. An encephalocele is a similar protrusion of the membranes of the brain, but accompanied by a portion of brain-substance itself. Both conditions are exceedingly rare, and are always the result of hydrocephalus. They may occur in any situation along the course of the sutures, but are most com-

mon at the internal and external angular processes of the orbit, and just below the occipital protuberance of the occipital bone. In the two former situations the protrusions take place through apertures left by the non-union of the sutures between the frontal and contiguous bones, and in the latter situation through an aperture at the spot where the four centres meet, from which the posterior portion of the occipital bone is developed.

The protrusion, when occurring in the occipital region, generally appears as a tumour of large size, globular, translucent, and frequently pedunculated. When at the internal and external angles of the frontal bone, it is generally small, somewhat flattened, bearing a great resemblance to the small dermoid cysts so common in this situation. Unlike the latter, however, meningoceles and encephaloceles are always congenital, cannot be raised from the skull, and frequently pulsate.

Series A. 131.—A sac, formed in the occipital region by protrusion of the dura mater through an aperture in the occipital bone similar to those in the spine shown under *spina bifida*. With the dura mater a portion of brain covered with pia mater and arachnoid is protruded. The aperture in the occipital bone is about two lines in diameter and situated in the median line below the spine.

HYDROCEPHALUS.

The following specimens exhibit some of the effects of hydrocephalus.

Hydrocephalic skull. Sub-series E. 1.—Skull of a child about ten years old. The sagittal suture and the middle portions of the coronal and lambdoidal sutures are open. The parietal, and the upper portions of the frontal and occipital bones are much larger than is natural, and very thin and light, and the inferior occipital fossæ bulge out in large rounded prominences. The principal enlargement of the skull is in its posterior part.

Subseries E. 2.—Skull of a girl eleven years old. The enlargement of the skull in consequence of hydrocephalus is effected by its elongation, and by the depression and hollowing of its base. An increase of width appears to have been prevented by the premature and complete closure of the sagittal suture. The coronal suture, and that between the frontal bone and the lesser alæ of the sphenoid, are wide open. The superior walls of the orbits are pressed downwards. The bones, generally, are thin and light, and in many parts of the inner table are deep depressions and foramina. See also Sub-series E. 3; and Series A. 140, 141, 141 a, 141 b, 142.

Effects of hydrocephalus upon the brain. VI. 41.—Portions of cerebrum, exhibiting the septum lucidum stretched in consequence of the

distension of the lateral ventricles with fluid. In the anterior portion of the septum there is a large, irregular opening, traversed by thin shreds, and the posterior portion of the septum which remains is very thin.

VI. 42.—A similar specimen, except that the opening is in the posterior portion of the septum lucidum, and has smoother and more even edges.

VI. 64.—Part of a brain of a man, twenty-eight years old, who had hydrocephalus in his infancy, and whose head was enlarged and somewhat deformed in consequence of that disease. The whole of the internal surface of the ventricles is finely granulated, and appeared to be indurated. The inferior surface of the edges of the fornix is intimately adherent to the surface of the choroid plexus and through its medium to the upper surface of the optic thalami. The mind of the patient appeared in no small degree affected by this disease; he was a very skilful furniture painter, and died of a disease independent of the state of his brain.

CHAPTER VIII.

COMPARISON OF THE VARIOUS DEFORMITIES OF THE SKULL, SPINE, THORAX, AND PELVIS.

HERE it may be well to compare the various distortions of the skull, spine, thorax, and pelvis, which have been described under Diseases of the Bones, Spine, and Cranium.

THE SKULL.

Compare the rickety skull (Sub-series A. 148) *with the hydrocephalic skull* (Sub-series E. 4).

In rickets the skull is slightly enlarged; the frontal bone is high, square, and projecting; the fontanelles are open; the bones are thickened, soft, and spongy.

In hydrocephalus the cranium is enormously enlarged; the frontal bones are very prominent, and the parietal bones bulge out on either side. The sutures are open; the bones are widely separated; the brain between the bones is covered by a thin membrane, in which separate centres of ossification, leading to the formation of Wormian bones, occur. The bones, generally, are thin and light. The superior walls of the orbits are pressed downwards and appear almost vertical instead of horizontal.

THE SPINE.

Compare the distortions of the spine produced by angular curvature (Sub-series D. 34), *by lateral curvature* (Sub-series D. 16), *and by posterior curvature* (Sub-series D. 18).

In angular curvature one or more of the bodies of the vertebræ and intervertebral cartilages are destroyed, and the upper portion of the spine is approximated to the lower, forming with it an angle projecting backwards.

In lateral curvature the spine is curved laterally, and generally rotated at the same time on its own axis. The intervertebral carti-

lages are laterally compressed, but neither the cartilages nor vertebral bodies are ulcerated.

In posterior curvature the spine is curved with its convexity backwards; the intervertebral cartilages are compressed anteriorly, but neither the intervertebral cartilages nor the bodies of the vertebræ are ulcerated.

THE THORAX.

Compare the distortion of the thorax in rickets (Sub-series D. 17) *with that in lateral curvature* (Sub-series D. 16) *and with that in angular curvature* (Sub-series D. 30).

In rickets the thorax is increased in its antero-posterior diameter and diminished in its lateral, and "a shallow longitudinal groove is formed on each side of the chest, parallel and a little external to the sternum" (Gee).

In lateral curvature the thorax is unilaterally distorted; one side is increased in its antero-posterior diameter and diminished in its lateral, and the other side is increased in its lateral and diminished in its antero-posterior. (See p. 180 for full description.)

In angular curvature the thorax is symmetrical, but bends down towards the pelvis, so that the lower ribs may reach the ilium. "The vertical measurement is decreased, while the antero-posterior is considerably increased, and the sternum is carried forward, so that it is in a vertical plane considerably anterior to that of the face" (Wilks and Moxon).

THE PELVIS.

Compare the distortions of the pelvis in rickets (Sub-series A. 164, 176), *in mollities ossium* (Sub-series A. 180), *in lateral curvature* (Sub-series D. 16), *and in the oblique distortion of Naegelé* (Sub-series D. 145).

In rickets the pelvis is generally flattened from before backwards. The symphysis pubis is driven in, giving the inlet an hour-glass shape. The sacrum is more horizontal than natural, its curves are diminished, its promontory is pressed forwards and downwards into the pelvic cavity, and its apex, with the coccyx, is curved acutely forwards and inwards. The iliac crests are everted and curved boldly forwards. The tuberosities are widely separated, and the pubic arch is increased in width.

In mollities ossium the pelvis is flattened from side to side. The symphysis pubis projects in the form of a beak, giving the pelvis a rostrated appearance. The curves of the sacrum are increased

The iliac crests are inverted and folded up. The tuberosities are approximated, and the pubic arch is diminished in width.

In lateral curvature the pelvis is often natural or but slightly affected; its obliquity may be lessened, its antero-posterior diameter diminished, and its transverse increased.

The antero-posterior axis, corresponding with the lumbar curve, may be directed obliquely from before backwards, and from right to left, or left to right, according to the direction of the curve. The tuberosity on the side of the curvature is higher than that on the opposite side.

In the oblique distortion of Naegeli the sacrum is ankylosed to one or other of the iliac bones, and the lateral half of the sacrum which is fused with the adjoining iliac bone is imperfectly developed. The whole sacrum is deflected towards the ankylosed side, and its anterior surface looks in the same direction. The symphysis pubis is displaced towards the side opposite to that on which the sacro-iliac fusion obtains. The oblique diameter, which extends from the ankylosis to the acetabulum of the other side, is increased, and the remaining oblique diameter is diminished. "The distance of the promontory of the sacrum from the acetabulum on the ankylosed side is much less than the same measurement on the opposite side." (Tyler Smith.)

In angular curvature the pelvis is but little altered; it sometimes appears, like the thorax, a little deeper than natural.

CHAPTER IX.

INJURIES AND DISEASES OF NERVES.

WOUNDS OF NERVES.

WOUNDS of nerves may be incised, punctured, lacerated, or contused. Of these, incised wounds alone are illustrated in the Museum.

Incised wounds may be classed as complete or incomplete, according as the nerve is completely or only partially divided.

Process of repair after complete division.

When a nerve is divided in its continuity both portions slightly retract in consequence of their elasticity, the proximal end becomes slightly swelled and hypervascular, the distal end atrophied from fatty degeneration, inflammatory material is produced between the divided ends, and the nerve is ultimately restored. The process by which this restoration is accomplished is doubtful. By some it is maintained that spindle-shaped cells are developed in the inflammatory material and become connected above and below in some unexplained manner with the divided nerve-fibres, and are ultimately developed into axis-cylinders. Others affirm that the axis-cylinders in the proximal end grow out, as it were, into the material uniting the two portions, and become united either to the old axis-cylinders in the peripheral end (which appear, after having undergone considerable degenerative changes, to be restored to their natural condition) or to newly formed axis-cylinders which have taken their place.

By some, immediate union, similar to that of soft tissues, is believed to occur. This belief, however, is only based on the clinical evidence that in some cases, after division of nerves with complete loss of function of the parts supplied by them, the functional activity has been rapidly restored. Such a method of union, however, has never been verified by examination of the parts after death; neither has it been observed in experiments upon animals. The restoration of function may, moreover, be explained on the sup-

position that a complementary nervous action is exercised by peripheral recurrent branches.

When the two portions are widely separated, as by the interposition of some tissue between them, the distal portion undergoes atrophy more or less complete, whilst the upper usually becomes bulbous, though its fibres undergo but little change. The parts supplied by the wounded nerve generally undergo atrophy and degeneration.

VIII. 23.—The ulnar nerve and adjacent parts, from the forearm of a man who had received a severe wound fourteen years before death. At the junction of the middle and lower third the nerve had been completely divided. The upper end of the nerve appears a little less than its normal size, and about three quarters of an inch above the point of division there is a well-marked bulbous enlargement, which, under the microscope, showed a condition very like atrophy. The lower end of the nerve is much atrophied, and under the microscope it was found to consist almost entirely of connective tissue, with an occasional indication of axis-cylinders. The lower end of the nerve is attached to the under surface of the tendon of flexor carpi ulnaris, its upper end to the upper and inner aspect of the same tendon. The two portions of the nerve are not on the same plane, and much scar tissue intervened between them.

There was complete atrophy of all the muscles of the hand supplied by the ulnar nerve, with contraction of the little and ring fingers. Sensation was, however, perfect in the skin supplied by the nerve.

When a nerve is divided and the peripheral portion removed, as in amputation, the divided end of the proximal portion becomes bulbous and adherent to the tissues of the stump, the bulbous condition being due to the formation of connective tissue about the sheath. There is usually but little atrophy of the nerve-trunk; in the case of the optic nerve, however, after the removal of the eye, the nerve becomes greatly atrophied and shrunken within its sheath, but no bulbous condition is seen. If the end becomes involved in the cicatrix, or in inflammation or ulceration of the stump, severe pain is experienced, often necessitating reamputation.

VIII. 2.—An anterior crural nerve from a stump. The extremity of the nerve forms a hard bulbous swelling, into which the section of the nerve shows that its component fasciculi are continued.

VIII. 4.—Portion of a scapula, with the axillary nerves and artery, from a person in whom amputation of the arm at the shoulder-joint had been performed a considerable time before death. The several nerves are firmly united together, and their extremities form hard bulbous swellings, which are adherent in one mass to the cicatrix in the skin.

VIII. 7.—Nerves of a forearm, with the bones, from a stump. The

extremities of the radial, ulnar, and median nerves form very dense, bulb-like swellings, two of which are closely, and one more distantly, connected with the cicatrix in the skin. See also VIII. 9, 10, 11, and 15.

IX. 20.—The eyelids, the remains of the optic nerve, and the other contents of the orbit, from which the eye IX. 17 was removed. The optic nerve terminates by a blunt, but not bulbous, extremity, which is firmly adherent to the surrounding tissues. The eyelids, muscles, and all the other parts are atrophied and contracted.

VIII. 24.—A stump, reamputated on account of constant pain and ulceration. There was found marked thickening of the sheath of the musculo-cutaneous nerve, which was also in a state of tension. The nerve was traced down to the ulcer, where it is probable its free extremity was exposed. There was the usual bulbous enlargement of the posterior tibial and other nerves.

Process of repair after partial division.

After partial division the portions divided will retract, so putting the undivided portion on the stretch, thereby causing serious local and constitutional disturbance. Union of the divided portions is accomplished in a manner similar to that described under complete division.

VIII. 14.—Portion of a radial nerve, with the tendons of the flexor carpi radialis and flexor pollicis muscles. Long before death the artery was completely, and the nerve partially, divided. The divided filaments of the nerve have become firmly adherent to the two contiguous tendons. The sensibility of the fingers was unimpaired.

ATROPHY.

The occasional atrophy of the distal portion of a divided nerve and atrophy of the optic nerve after extirpation of the eyeball have already been referred to under Wounds of Nerves. Atrophy may likewise occur after any severe injury to a nerve-trunk, after pressure upon a nerve by a tumour or an aneurism, or after destruction or degeneration of the organs which the nerve supplies.

An atrophied nerve appears shrunken and contracted within its sheath, and on microscopic examination few, if any, nerve-fibres can be discovered, the greater number having undergone granular and fatty changes.

From compression by a tumour in the course of a nerve. VIII. 19.—A right recurrent laryngeal nerve. The mass of the tissue which surrounds it consists of dense scirrhus material involving one of the cervical glands. The nerve-fibres are not merely surrounded and compressed, but are separated from one another by the penetrating of the cancer growth between them. The left recurrent nerve was equally involved.

The man from whom these nerves were removed had suffered for nine months from cancer of the thyroid body, and secondarily of the glands of the neck. His voice became by degrees weak and indistinct, scarcely more than a whisper, and before death he suffered from aphonia.

From destruction of the part supplied by the nerve. VIII. 3.—Portion of a cerebrum, with the optic nerves, and some remains of the left eye. The eye is contracted, in consequence of the escape of its humours, and the left optic nerve is much diminished in size, from the retina to the optic commissure. Between the commissure and the optic thalamus, the nerve on the right side is smaller than that on the left, and the right thalamus is smaller than the left.

From a person who had been blind in the left eye, from childhood, in consequence of small pox.

VIII. 5.—Portion of a cerebrum, with the optic nerves and remains of the left eye. The cornea is opaque, and the coats of the eye are collapsed. The left optic nerve is considerably diminished in size between the diseased eye and the optic commissure. Behind the commissure, the nerve on the right side is rather smaller than that on the left; but the thalami appear to be of equal size.

VIII. 6.—Portion of a cerebrum, with the optic nerves and the eyes. The optic nerves are considerably diminished in size, thin, and flat, in their whole course from the retina to the thalami. The optic thalami are also small. The eyes are reduced in size, from a deficiency of their humours, but are not otherwise altered.

From an aged woman, who had been totally blind for twelve years.

TUMOURS OF NERVES.

The term *neuroma* was formerly applied to any tumour growing upon a nerve, without reference to its structure. It should, however, be restricted to those rare forms of tumours which are composed of nerve-elements themselves, and other tumours connected with nerves should be called, as in other situations, *fibromata*, *myxomata*, &c., according to their structure.

Of nerve tumours the fibrous or *fibromata* are by far the most common. They spring from the neurilemma or connective tissue surrounding and connecting the nerve fibres. They may involve the whole of the nerve or only a part of it, the rest being spread out over them. They resemble the *fibromata* in other situations, are encapsulated, and generally single; but more than one tumour may occur upon the same nerve, and instances have been recorded of many such on nearly all the nerves of the body.

Another form of fibrous tumour connected with nerves is the small "painful subcutaneous tubercle" of Paget.

The *myxomata* are the next most common form of nerve tumours. They resemble the *myxomata* in other situations.

Sarcomatous and *carcinomatous* tumours are also found.

True neuromata are rare, and are not represented in the Museum.

Fibromata.

VIII. 16.—An ischiatic nerve, with a small, firm, white tumour within its sheath. The filaments of the nerve are separated by the tumour, and loosely connected with its surface.

VIII. 20.—Portions of the internal cutaneous and posterior interosseous nerves, from the forearm of a woman, aged seventy-five, to which large fibrous tumours are attached and included amongst the filaments. In other portions of the nerve smaller tumours of varying size are seen more or less completely invested. The larger ones had existed for more than thirty years; they occasioned considerable pain.

VIII. 22.—A large tumour of fibrous structure which has undergone in its central portion degeneration and softening. It grew in connection with the muscular spinal nerve of a man, aged forty. It had been many years in progress. It was removed with the part of the nerve which it involved, the patient making a good recovery, but who had subsequently paralysis of the parts to which the muscular spinal nerve is distributed.

VIII. 1.—A posterior tibial nerve, in which there is a circumscribed oval tumour, composed of a soft grumous substance. The component fasciculi of the nerve are separated and spread out around the tumour; the peroneal nerve is adherent to the surface of the neurilemma extended over the tumour. A section of the tumour with drawing is preserved in the Microscopical Cabinet (A. 26).

VIII. 12.—Portion of an axillary artery, with the axillary plexus of nerves and a tumour connected with them. A section has been made of the tumour, to show its interior consisting of soft fleshy substance. A nerve, presumed to be the median, is connected with the tumour at its upper and lower extremities. At its upper end the filaments of the nerve are expanded over the tumour in such a manner as to indicate that it commenced within the nerve. A section of the tumour with drawing is preserved in the Microscopical Cabinet (A. 27).

VIII. 13.—A median nerve, in which there is a fibrous tumour. The tumour was completely embedded in the substance of the nerve, the filaments of which are separated and extended around it. A section of the tumour is preserved in the Microscopical Cabinet (A. 28).

Sarcomata.

VIII. 17.—A portion of one of the nerves of a brachial plexus, probably one of the roots of the median nerve, with a tumour in its sheath. The tumour is of an oval form, nearly an inch in length; it lies completely within the sheath of the nerve, the bundles of nervous filaments being pressed to one side; and it is composed of a pale, uniform, firm, elastic, glistening substance, which appears in one situation somewhat softened. The patient was a man about twenty-five years old, in whom the tumour had grown slowly, and with much pain in the arm. A section of the tumour is preserved in the Microscopical Cabinet (A. 29).

CHAPTER X.

INJURIES AND DISEASES OF THE ORGANS OF CIRCULATION.

INJURIES OF THE HEART.

RUPTURE.

RUPTURE of the heart is rare. When it occurs it is the result of great violence applied to the chest-walls, or of some sudden violent exertion; but in the latter case there is generally pre-existing disease of the heart-walls to account for it. In severe injuries of the head or lower extremities the heart has occasionally been found ruptured, although no direct violence has apparently been applied to the chest. Rupture in such cases has been attributed to sudden spasmodic action of the heart from intense fear.

When the result of external violence the rupture may take place through any part of the heart, but perhaps more often through the right side on account of the closer proximity of that part to the chest-walls; when the result of sudden over-action of the heart, it is nearly always confined, as might be expected, to the left ventricle. The pericardium may or may not be involved in the rupture.

XII. 54.—A heart and large vessels, with the trachea, and a portion of the left lung, from a child six years old. An irregular rent extends through the whole length and thickness of the posterior wall of the left ventricle and auricle. A similar laceration extends through the upper part of the anterior wall of the left ventricle, and through the adjacent part of the septum. The left bronchus is torn across near the root of the lung.

These injuries were the results of the passage of a heavy wheel over the chest of the child. Some of the ribs were fractured, but the pericardium was not torn. General emphysema was produced by the escape of air from the ruptured bronchus.

XII. 74.—A heart, in which a partial rupture of the walls of the auricles has taken place. In the posterior part of the right auricle, between the fossa ovalis and inferior vena cava, a rent an inch and a half in length extends through the endocardium. In the posterior

part of the left auricle, between and below the orifices of the pulmonary veins, a rent nearly two inches in length exists in both the pericardium and endocardium, and there is a small aperture between some of the muscular fibres thus exposed, through which a little blood escaped into the pericardial cavity.

The patient was thirty-eight years old. His leg was crushed by a heavy weight, and amputation was performed on the following day. He seemed to suffer but little from these shocks, and went on well till the fifth day, when extensive inflammation ensued in the tissues of the thigh. He was much depressed, but his case was not deemed hopeless till the twelfth day, when he suddenly became pale and more exhausted and quickly died. From the time of the injury the pulse was generally feeble and frequent. During the last few days of his life the breathing was oppressed. A clot of blood, about the size of a half-crown, was loose in the pericardial sac, and a smaller clot lay upon the auricles. Several small effusions of blood existed between the pericardium and the muscular substance of the auricles and ventricles, especially of the former. The texture of the heart appeared quite healthy.

WOUNDS.

Wounds of the heart are generally the result of bayonet-thrusts, gun-shot injuries, or knife-stabs. They have occasionally been produced by the penetration of a needle.

As a rule they are immediately fatal, especially when of large size or transverse to the muscular fibres of the ventricles, as under these circumstances, the wound gapes and allows of sudden hæmorrhage into the pericardium. When the wound is parallel to the fibres of the ventricle death may be delayed, as the spiral arrangement of the different layers of fibres has a tendency to occlude the wound.

Wounds of the auricles, on account of the thinness of their walls and the absence of a spiral arrangement of their muscular fibres, are more fatal than those of the ventricles; cases of recovery have, however, been reported. The right side of the heart, from its position, is necessarily more exposed to wounds than the left. The pericardium alone is sometimes injured. An interesting specimen of a hernia of omentum into the pericardium after a wound follows.

XII. 71.—Part of the heart of a lunatic, who destroyed himself by thrusting a needle, about an inch and a quarter in length, through the anterior wall of the left ventricle four days before death. The needle, entering just to the left of the septum, passes obliquely upwards and to the left, and its point enters the cavity of the ventricle through the apex of the anterior fleshy column; its larger end is buried in the substance of the ventricle. The pericardium was thinly covered with inflammatory material, and the muscular substance of the heart was in a state of fatty degeneration, which was most advanced and attended with softening of texture in the neighbourhood of the needle.

XII. 72.—Part of the left ventricle of a cow, through which an awl was driven at some time not less than two days before death. The whole thickness of the ventricular wall is pierced; one end of the awl projecting half an inch into the pericardiac sac, the other into the cavity of the ventricle. No external wound was noticed in this case, nor any signs of severe suffering. The cow walked two miles to the slaughter-house, where, on immediately killing her, the injury of the heart was discovered.

XII. 141.—Pericardial diaphragmatic hernia of the omentum, probably the result of a wound of the floor of the pericardium. (See Catalogue.)

INJURIES AND DISEASES OF THE ARTERIES.

WOUNDS.

Specimens illustrating a few of the various ways in which the arteries may be wounded are here appended. As pathologists our attention, however, will be chiefly confined to the consideration of the results of wounds of arteries.

XIII. 49.—An anterior tibial artery, in which a small lacerated aperture, completely penetrating its coats, was made by the sharp end of a fragment of bone in a case of compound fracture.

XIII. 64.—A femoral artery, the inner and middle coats of which were lacerated in a case of compound fracture. The laceration extends transversely round two thirds of the artery just above the origin of the profunda.

XIII. 99.—Arteries of a leg, with portions of the surrounding muscles, from a man in whom the peroneal artery was penetrated by a knife which passed transversely into the back of the leg from the inner side. The track of the wound into the peroneal artery is shown by the piece of coloured glass. The peroneal artery is unusually large; the posterior tibial, into which a bristle has been introduced, is very small.

XIII. 116.—A common carotid artery, into which the smaller end of a tobacco-pipe was driven a few days before death. At the upper part of the preparation is shown a portion of a sloughing cavity, in which the wounded part of the artery is involved and from which the external and internal carotid arteries proceed.

The patient was a young man. The tobacco pipe was accidentally driven through the tonsil into the artery at the angle of its bifurcation. He supposed that he had completely withdrawn it; but a portion of the pipe, an inch long, remained in the wound, closing the orifice which it had made in the artery, and preventing hæmorrhage. Extensive suppuration followed, in the course of which hæmorrhage ensued. The trunk of the artery was tied seven days after the accident, but hæmorrhage recurred twice, and the patient died four days and a half after the application of the ligature.

RESULTS FOLLOWING WOUNDS OF ARTERIES.

The results following a wound of an artery depend upon whether the interior of the vessel is laid open, or the walls merely notched but not penetrated; whether the vessel wounded is of large or small size; or whether it is completely or only partially divided.

I. WHEN THE INTERIOR OF THE VESSEL IS LAID OPEN.
(PENETRATING WOUNDS.)

When the vessel is of large size.

Wounds of the large vessels, such as the aorta or pulmonary artery, are, in most cases, immediately fatal. When, however, the wound is very small death may be delayed for a few hours; such was the case with the patient from whom the following specimen was obtained.

XII. 97.—The heart and the commencement of the great arteries of a woman, aged twenty-five, who died under the following circumstances:—She received a blow on the chest, whereby a needle which fastened her shawl was driven through the second intercostal space of the right side in its upper part, close to the border of the sternum, passing between the bone and the internal mammary artery. It penetrated to the extent of about two inches, and was broken off on a level with the skin. No immediate effect was apparent. She came to the hospital, and the portion of the needle, which appeared firmly fixed, was extracted. When the broken end was exposed by a small incision it was observed to move slightly with the heart's action. She was persuaded to remain with difficulty. In less than an hour she became very faint. The faintness rapidly increased, and she soon died.

In a post-mortem examination the pericardiac sac was found distended with blood, which had separated into clot and serum, the former completely investing the heart. The blood effused amounted to nearly a pint. In the wall of the aorta is seen a minute aperture (through which the portion of the needle is passed), and near it are two other smaller wounds, only one of which appeared to have completely perforated the wall. They are just below the point where the pericardium is reflected, the opposite portion of which presented a corresponding aperture. No other injury could be detected.

When the vessel is of the second or third degree.

When an artery of the second or third degree, such as the femoral or brachial, is wounded, different results follow, according as it is completely or only partially divided.

Results following complete division.—When the edges of the wound are cleanly cut repeated hæmorrhages rapidly terminating in death will ensue; but when the edges are uneven, ragged, and torn, as in the evulsion of a limb by machinery or by a cannon ball, the internal

coat and sheath of the vessel become twisted coil-like, the middle and internal coats retract and contract, and clots form within the vessel and about the torn end. By these means the artery is securely closed, and hæmorrhage effectually prevented. A similar condition of the ends of the vessels prevents hæmorrhage from the umbilical cord after it has been gnawed through by animals in the separation of their young. The further changes leading to permanent occlusion will be described later.

Results following partial division.—When the wound is at all large, and made transversely to the long axis of the vessel, hæmorrhage and death will rapidly ensue; but when the wound is small—a mere puncture—or parallel to the axis of the vessel, the wound may heal by adhesive inflammation. This adhesion may be permanent, or the cicatrix may yield to the pressure of the blood, so giving rise to one form of traumatic aneurism.

Or, again, blood may be effused into the tissues around the artery, the wound in the integument and other soft tissues may heal, and the effused blood become encysted from condensation of the soft parts, so giving rise to a second form of traumatic aneurism. The subsequent changes undergone by the effused blood and its containing cyst are similar to those which occur in spontaneous aneurisms.

A transverse wound of an artery assumes a lozenge-shape. This has been shown by Mr. Savory to depend upon the longitudinal tension in which an artery is normally placed, and not upon contraction of the muscular fibres, as he found that a transverse wound of an artery after death assumed the same shape.

When the vessel is of small size.

When a vessel of small size is completely divided it retracts and contracts within its sheath, and a clot forms within and also without on the roughened surface of the sheath. Thus the vessel is effectually but only temporarily closed, it becomes so permanently by the union of the internal and middle coats by adhesive inflammation and by the organization of the internal clot. The artery ultimately shrinks into a fibrous cord as far as the first collateral branch.

When the artery is completely divided in its continuity, the distal as well as the proximal end is closed in this manner.

When a small artery is but partially divided, its ends are unable to retract and contract to their full extent, and repeated hæmorrhages ensue. Continued hæmorrhage from a partially divided vessel was common when bleeding was performed by puncturing

the temporal artery; the hæmorrhage was generally stopped by completing the division of the artery.

II. WHEN THE VESSEL IS NOT LAID OPEN. (NON-PENETRATING WOUNDS.)

When the walls of a vessel are merely notched but the interior of the vessel is not laid open, the wound may heal; or the uninjured coat or coats may ulcerate and give way and hæmorrhage ensue; or again, after healing has taken place the cicatrix may yield to the pressure of the blood, so giving rise to a traumatic aneurism.

RUPTURE.

When an artery yields to pressure from within or to force from without and there is no accompanying wound of the integuments the artery is said to be ruptured.

Rupture due to force from within, *i.e.* from increase of blood pressure, occasionally happens as a consequence of over-exertion, palpitation, &c.; but in these cases there is generally some pre-existing disease of the arterial walls.

Rupture by force from without may be due to a blow or sprain or to the over-exertion of a limb; it may occur in cases of severe fracture, or during the processes of reduction of old dislocations, or the breaking down of adhesions in cases of stiff joints.

XIII. 56.—An external iliac artery torn completely and straight across. The rupture occurred in an injury, by which the lower part of the femur was fractured.

XIII. 104.—Portions of a popliteal artery and vein. The artery was completely torn across by a wheel passing over the limb.

XIII. 88.—Portion of a brachial artery, ruptured from a fall whilst the arm was extended.

The results of the rupture of an artery will depend upon whether the rupture is partial or complete.

When the rupture is partial, i.e. when the internal and middle coats alone are ruptured, the external may gradually yield to the pressure of the blood and become the sac of a false aneurism, or the internal and middle coats may retract and infold into the interior of the vessel, obliterating its calibre and so possibly producing gangrene of the limb.

When the rupture is complete, i.e., when all the coats are torn through, blood is extravasated into the tissues of the limb. If the artery is of large size the extravasation may occur to an enormous extent, tearing up the tissues and ultimately producing gangrene by pressure upon the collateral blood-vessels (diffused traumatic aneurism).

XIII. 88.—Portion of a brachial artery, which was torn straight across by external violence.

The patient, a gentleman sixty-nine-years old, fell with his arm stretched out. At first he seemed little injured, but pulsation was lost in the radial and ulnar arteries. In a few hours the arm became enormously swollen and livid, and amputation near the shoulder was performed. The brachial artery sloughed after being tied at the amputation.

When the artery is of smaller size, and the force of the blood pressure consequently less, the extravasated blood may become encysted by inflammation and condensation of the tissues around (circumscribed traumatic aneurism).

No specimen.

Under some circumstances, however, the artery retracts and contracts within its sheath, but little hæmorrhage occurs, an internal and external clot form, and permanent occlusion is accomplished, as already described.

XIII. 56.—An external iliac artery, torn completely and straight across. The torn ends of the artery are an inch apart, and are connected by a coagulum of blood. The coats of the artery are not obviously diseased.

The rupture was directly under Poupart's ligament.

XIII. 104.—Portions of a popliteal artery and vein. The artery was completely torn across by a wheel passing over the limb, and its divided extremities are separated to a distance of nearly half an inch. They are widely open. In the upper part of the artery a coagulum is formed, which almost fills its cavity; in the lower part there are only some irregularly shaped portions of fibrine.

EFFECTS OF THE APPLICATION OF A LIGATURE.

I. TO THE DIVIDED END OF AN ARTERY IN AN OPEN WOUND.

When a ligature is properly applied, the internal and middle coats are evenly and transversely cut through by its pressure, their cut edges retract and incurve within the canal of the vessel, and the external coat, crumpled up and tightly embraced by the ligature, retains the two inner coats in contact with each other. A clot of blood of conical shape forms in the vessel from the seat of ligature to the first collateral branch above, and becomes adherent by its base to the walls of the vessel. The cut ends of the internal and middle coats unite by adhesive inflammation. The external coat, where it is embraced by the ligature, ulcerates and sloughs, and the ligature comes away, generally bringing with it the end of the artery round which it was tied. Finally, the part of the artery between the seat of ligature and the first collateral branch above

becomes converted, together with the clot in its interior, into a fibrous cord.

The above changes may now be studied in detail by the aid of specimens.

Division of the internal and middle coats.

XIII. 118.—A femoral artery and vein. They were cut through in an amputation, and the artery was tied eleven hours before death. The preparation shows the division of the internal and middle coats of the artery by the ligature, and how their divided borders are retracted and incurved within the adjacent parts of the canal.

XIII. 66.—A femoral artery, showing the effects of a ligature placed round it a few days before death. The ligature was applied at a little distance from the extremity of the artery, and it has divided the inner and middle coats. For two inches above the ligature the artery is filled by coagulum.

The even, smooth, and complete division of the internal and middle coats, so essential for successful union by adhesive inflammation, is best accomplished by a small round ligature. The effects of different kinds of ligature are seen in the following specimen.

XIII. 32.—Portion of an artery, exhibiting the division of its middle and internal coats by three different kinds of ligature, viz. the large round, the small round, and the flat, ligature. The ligatures employed were composed of the same materials as those which are tied round the portion of artery by the side of that on which the experiment was made. The small round ligature, which is in the middle, made the cleanest and most complete division of the coats; the division by the flat ligature is uneven, incomplete, and attended by partial separation of the adjacent part of the divided coats.

The experiment was made on a dead artery.

Formation of clot.

A few hours after a vessel has been tied a clot commonly forms at the seat of ligature and gradually extends up the artery to the first collateral branch. When fully formed it appears of a conical spiral shape, attached at its base to the walls of the vessel, but free and moveable above. It is white below, but gradually assumes a red colour towards its apex.

Although the clot is generally ascribed to the coagulation of the blood, which is said to be stagnant in the portion of artery between the seat of ligature and the first collateral branch, it is by some attributed to the gradual deposition of fibrine from the blood, an explanation the more probable, as Mr. Callender has shown that the blood is not stagnant in the portion of an artery above the ligature, but, on the contrary, is agitated in an orderly manner, so

that the fibrine is, as it were, churned out of the blood to form the coagulum. Upon this orderly movement of the blood is believed by Mr. Callender to depend the conical and spiral shape of the clot, its cessation at the first collateral branch where the churning movement ceases, and the white appearance which its base assumes from the first. The dark red colour of the upper portion of the clot is due to the coagulation of the blood upon the already deposited fibrine.

Although in the majority of cases a clot forms as just described, in some instances occlusion is accomplished without the formation of a clot.

XIII. 35.—Parts of a femoral artery and vein, from a stump. The extremity of the artery is closed by a conical clot, which extends up the vessel to the origin of the nearest branch. The base of this clot is united to the extremity of the artery. The extremity of the vein is closed by a similar but smaller clot. The coats of the artery and vein are thickened and closely united to the surrounding parts.

XIII. 37.—Parts of a femoral artery and vein, from a stump. The extremity of the artery is open; but its canal is filled to some distance by a coagulum, which adhered firmly to its coats.

XIII. 129.—The femoral artery from the body of a man, who died eleven days after amputation of the thigh. Its canal is much contracted and wrinkled transversely. By its side is suspended the clot which it contained, of a deep red colour above, but white below, and of an irregular and spiral shape.

Union of the internal and middle coats by adhesive inflammation.

XIII. 38.—Parts of a femoral artery and vein, from a stump. The extremities of both the artery and vein are closed, and intimately connected with the surrounding tissues. Both of them have coagula above their closed extremities.

XIII. 36.—Parts of a femoral artery and vein, from a stump. The extremity of the artery is closed by the adhesion of its sides, but there is no clot within it. The extremity of the vein is open.

Separation of the ligature.

The pressure of the ligature on the external coat gradually produces ulceration and sloughing of that coat, and the ligature cuts its way out, generally bringing with it the portion of artery around which it was applied.

XIII. 155.—This ligature was used to tie the subclavian artery (in the third part of its course) of a man, aged fifty-four, for a large axillary aneurism. It came away with the attached slough on the twentieth day after operation.

Conversion of the artery above the seat of ligature into a fibrous cord.

The process by which the artery and contained clot are converted into a fibrous cord is discussed in the section "Adhesive Phlebitis," under "Organization of the Clot" and "Changes in the Vessel Walls." See pages 256 and 257.

No specimen.

II. TO THE CONTINUITY OF AN ARTERY, AS IN THE HUNTERIAN OPERATION FOR ANEURISM.

When a ligature is applied to an artery in its continuity, changes take place similar to those which occur when a ligature is applied to a cut end of a vessel; the external coat is embraced and crumpled by the ligature; the internal and middle coats are evenly divided, and retract and contract into the interior of the vessel; a conical clot is formed both above and below the seat of ligature, but the clot below the ligature is less firm than that above. The cut ends of the internal and middle coats unite by adhesive inflammation, and the clots filling the artery above and below the seat of ligature become organized. The ligature by its pressure causes sloughing of the external coat and comes away, cutting the artery into two pieces. These two pieces afterwards unite by adhesive inflammation, so that the spot where the ligature was formerly applied can no longer be recognised, and the artery between the first collateral branch above and the first below the seat of ligature becomes converted, together with the clots, into a fibrous cord.

Division of internal and middle coats.

XIII. 6.—Part of the aorta of a dog, exhibiting the effects of a ligature applied twenty-four hours before death. The inner and middle coats are partially divided, and above the seat of the ligature is a conical coagulum, which appears laminated and is loosely attached to the walls of the artery.

Formation of clots.

XIII. 123.—The iliac arteries of a man whose external iliac artery was tied four days before his death. The ligature was applied just above the orifice of the epigastric branch of the artery. Above this place, where now a constriction appears, the whole canal of the artery, to the origin of the iliac, is filled with a firm cylindrical blood-clot. Beyond the place of ligature a smaller conical clot extends for nearly an inch along the continued trunk of the artery.

XIII. 156.—The right common carotid artery of a man tied five days

before death. It shows a long conical clot, commencing from the ligature, on the lower portion.

Conversion of the artery into a fibrous cord.

XIII. 23.—A femoral artery, upon which a ligature was placed a considerable time before death. The canal of the artery above and below the obliterated part is gradually contracted into a conical form as it approaches that part. The upper and lower portions of the vessel are connected by condensed cellular tissue. For some way above and below the obliterated part, the coats of the artery are thickened, and in the upper portion a dry clot of blood is firmly adherent to the walls.

XIII. 114.—A femoral artery, with a popliteal aneurism. The artery was tied by the edge of the sartorius muscle eighteen months before death, and the aneurism was diminishing at the time of the patient's death. The femoral artery is completely obliterated, from the situation at which the ligature was applied to the origin of the profunda. An inch and a half of the length of this part of the artery is replaced by a solid round cord of fibrous tissue.

Establishment of the collateral circulation.

After the main artery is obliterated the blood finds its way to the parts below by means of the enlarging anastomoses between the branches given off from the artery above and below the seat of obstruction. Specimens of collateral circulation after ligature of the principal arteries follow.

F. 1.—A thorax, with the principal arteries injected, from a man in whom the left subclavian artery was tied on the first rib, six years before death. The portion of the artery between the situation of the ligature and the axilla is in Series VIII, No. 4. The circulation was maintained chiefly through the enlargement of the supra-scapular and infra-scapular arteries.

F. 2.—A fore-arm, exhibiting the anastomosis and enlargement of arteries consequent on division of the radial a little above the wrist. The principal anastomosis is effected by a large artery passing from the interosseous at the lower edge of the pronator quadratus muscle across the front of the radius, to the radial artery, about half an inch beyond the point of its division.

F. 3.—A limb in which the femoral artery was tied in the middle of the thigh eleven years before death for the cure of a popliteal aneurism. The portion of artery obliterated by the ligature is about two inches in length, and extends to the origin of the profunda. Below this obliteration the artery was found open, but contracted to its entrance into the ham, where the aneurism was situated. The injection of the vessels displays the collateral branches by which the circulation was continued; these are situated chiefly at the back of the thigh and close upon the femur.

F. 4.—Part of a lower extremity, in which the femoral artery was tied fifty years before death, for the cure of a popliteal aneurism. The portion of artery obliterated by the ligature and by the aneurism extends from the profunda downwards to the division of the popliteal. A mass of earthy matter occupies the situation of the obliterated artery in the upper part of the ham. The anastomosing vessels by which the circulation was continued are chiefly at the back of the thigh.

This operation was performed by John Hunter, and it was the fourth case in which he tied the artery at a distance from the aneurism.

FAILURE OF ONE OR MORE OF THE NORMAL PROCESSES THAT OCCUR AFTER THE APPLICATION OF A LIGATURE.

When, from some of the causes to be presently illustrated, one or more of the normal processes fail, secondary hæmorrhage or gangrene may ensue.

I. *Failure of formation of clot.*

Under some circumstances, as we have seen, although no clot forms in the artery above the seat of ligature, the end of the vessel still becomes closed by adhesive inflammation. Usually, however, when the formation of a clot fails, the force of the blood, unbroken by the presence of a clot, falls on the uniting end, and prevents the closure of the artery. The common cause of this non-formation of a clot is the too close proximity of the ligature to a collateral branch, springing from the artery above the seat of ligature, *i. e.* nearer the heart.

XIII. 21.—The arch of an aorta, with the left subclavian and axillary arteries. The left axillary artery is the seat of aneurism, for the cure of which the subclavian artery has been tied. The upper part of the preparation consists of the left subclavian artery and the arch of the aorta. By tracing the subclavian artery downwards, the situation where it has been tied will be recognised. On the side of the ligature nearest to the heart, the artery is pervious and of its ordinary size to its extremity, which was closed by only a small coagulum. Between this coagulum and the sides of the vessel, is an aperture into which a bristle is passed; through it blood had passed from the artery to the outward wound. At a short distance above the situation of the ligature several large branches arise. The portion of artery between the situation of the ligature and the aneurismal sac is completely closed by coagulum. The aneurismal sac also is in great part filled by laminated coagulum; its exterior is firmly attached to three of the ribs which have undergone partial absorption. Below the sac is the remaining part of the axillary, with the commencement of the brachial artery. The axillary artery from the point of its connection with the sac is quite pervious, and a large branch arises from it which divides into the sub-

scapular and circumflex arteries. The axillary vein is connected with the sac, and is pervious. The coats of the subclavian artery above the situation of the ligature were so brittle that they yielded to the slightest force.

The patient was a man thirty-eight years old. The aneurism appeared to have existed four months, and was first observed six months after an attack of acute rheumatism. He died after repeated hæmorrhages, on the thirteenth day from the application of the ligature.

II. *Failure of adhesion of internal and middle coats.*

When the internal and middle coats fail to unite, the internal clot of itself is unable to resist the force of the blood, and consequently yields when the ligature separates. A common cause of this non-adhesion is a diseased condition of the coats of the artery, such as atheroma, calcareous degeneration, &c. Another cause is the uneven division of the coats from the faulty application of a ligature, or the use of an improper one.

XIII. 40.—A femoral artery from a stump. Its coats are thickened and earthy matter is abundantly deposited in them. In consequence of the occurrence of hæmorrhage after the amputation a second ligature was placed around the artery, about two inches above its extremity. This ligature had separated before death, and a portion of whalebone is passed into the aperture through which it was withdrawn. The cavity of the artery, above and below the situation of this ligature, is filled by clots of blood, which extend to a considerable distance up the vessel. The cut end of the artery is open.

XIII. 59.—A femoral artery and vein, from a stump. The coats of the artery are generally thickened. No adhesion of its sides has taken place at the cut extremity; but for some distance higher up, its cavity is filled by coagulum. The extremity of the vein is closed.

III. 164.—The popliteal, tibial, and peroneal arteries of a man, aged sixty-five, a drunkard, who died after amputation through the lower third of the left leg for compound dislocation of the foot.

The arteries are throughout extensively diseased. The posterior tibial at the operation was cut through by the ligature, a second ligature including surrounding muscle being employed. The vessels were filled throughout with firm clots, that in the peroneal being less perfectly formed and lighter in colour than the others.

III. *Failure of establishment of collateral circulation.*

When from some cause or other the collateral circulation after the application of a ligature to a main artery fails to become established, gangrene of the limb below the seat of obliteration will ensue.

There are no specimens illustrating the failure of the establishment of the collateral circulation after the application of a ligature to an artery in the Museum.

ARTERITIS.

Arteritis or inflammation of the arteries may be acute or chronic.

ACUTE ARTERITIS.

Two forms of acute arteritis have been described; the one occurring as a general, the other as a circumscribed, inflammation. The existence of the former is, however, at the present day disputed.

Acute circumscribed arteritis, that is, inflammation of limited portions of the arteries, generally occurs in the smaller of those vessels, and is nearly always associated with the breaking down of inflammatory emboli; by some it is thought to be the result of syphilis. In the aorta it sometimes occurs spontaneously, leading to aneurism or rupture.

The arteries also become inflamed and ulcerated from the spread of ulceration from surrounding soft tissues. Under these circumstances the walls become thinned, and subsequently ruptured from the pressure of the blood current within.

Ulceration may also spread from the endocardium to the aorta in the case of ulcerative endocarditis.

XIII. 61.—A femoral artery and vein, which were exposed and partly destroyed in the progress of a phagedænic ulcer. The coats of the artery, to the extent of about an inch, are completely disorganized, and two small ragged openings are visible in this portion of the vessel. Above this part of the artery, a circular indentation in its walls may be perceived, which was occasioned by a ligature placed around it in consequence of hæmorrhage from the openings just mentioned. A portion of the vein is obliterated, and its cavity below the obliterated part is filled by a clot of blood.

The disease extended from the labia of a woman, and had destroyed a large portion of the perineum before it reached the groin.

See also XIII. 177. and 184.

XIII. 113.—Parts of a heart and aorta, exhibiting a transverse rent extending round the whole circumference of the inner and middle coats of the aorta, about half an inch above the valves. The torn coats are soft, but in other respects they appear healthy.

The patient was a man about twenty-five years old. He had delicate health; but was not supposed to have any disease of the heart. He was suddenly seized, while walking, with pain in the chest and faintness, and quickly died.

CHRONIC ARTERITIS OR ATHEROMA.

The condition of the arteries, long known as atheroma or atheromatous degeneration, is here called chronic arteritis, as recent microscopical research has shown that it primarily depends upon a chronic inflammation of the deeper layers of the intima. The disease in its early stages is characterized by greyish-white, slightly elevated patches upon the inner surface of the vessel; these were formerly thought to be exudations of lymph from the vasa vasorum upon the free surface of the lining membrane, and more recently to be deposits of fibrine from the blood itself. That neither of these theories is correct, but that the patches are due to cell infiltration in the deeper layers of the intima, is clearly demonstrated by sections, when the internal layers of the intima (those next the blood) are seen to pass uninterruptedly over the patches from which they can be readily stripped off.

XIII. 75.—The arch of an aorta, with the subclavian and carotid arteries. The deeper layers of the internal coat of the aorta are infiltrated with inflammatory products; the innermost layers are slightly elevated, but appear otherwise unaffected.

SECONDARY CHANGES IN CHRONIC ARTERITIS.

The inflammatory material in the deeper layers of the intima may undergo fatty, calcareous, or fibroid degeneration.

Fatty degeneration.

This is a common change in chronic arteritis. The inflammatory material in the deeper layers of the intima softens into a fatty mass, so that the atheromatous patches, which were formerly grey, now appear yellowish-white. These collections of fatty material are sometimes spoken of as atheromatous abscesses, and after the superficial layers, which separate the fatty material from the blood, have given way, as atheromatous ulcers.

XIII. 125.—The arch of an aorta with its branches. The internal coat is thickened, opaque, and tuberculated, and contains some fatty and calcareous matter.

XIII. 72.—An aorta, exhibiting atheromatous abscesses graduating into atheromatous ulcers, whose surface presents soft and earthy substance.

See also XIII. 1.

Calcareous degeneration.

Calcareous, like fatty degeneration, is a common change in chronic arteritis. The inflammatory material becomes infiltrated with

earthy salts at once, or after first undergoing the fatty change already described. In either case bony plates of various sizes and shapes are produced, often converting the artery into a rigid tube.

XIII. 85.—The arch of an aorta, with the carotid and subclavian arteries. Earthy and soft matter is seen in their coats.

XIII. 124.—Arch of an aorta, with a very large aneurism projecting through the front of the chest walls. There are thin scattered plates of fatty and calcareous matter in many parts of its coats.

XIII. 73.—Portion of an abdominal aorta, with large nodular and granular masses of calcareous matter apparently attached to its internal surface. Around these deposits the internal coat is thickened and opaque, and the bases of some of them are fixed on thin circular plates of earthy matter.

Fibroid degeneration.

This degeneration is less common than the two preceding; it consists in the conversion of the inflammatory material into fibrous tissue, and is characterized by a general thickening and induration of the arterial walls. According to some authors this change is the result of syphilis.

RESULTS OF CHRONIC ARTERITIS.

Among the results of chronic arteritis may be enumerated rupture, general or aneurismal dilatation, thrombosis, embolism, and gangrene of parts supplied by the vessel.

Rupture.

XIII. 110 is probably a specimen of rupture from chronic arteritis.

Dilatation.

1. *General dilatation.*—XIII. 57.—A subclavian and axillary artery. The coats of the artery, especially the inner coat, are atheromatous; and its cavity is generally dilated.

XIII. 8.—The arch and thoracic portion of an aorta uniformly dilated. The coats of the artery are generally thickened and indurated.

XIII. 74.—Portion of an abdominal aorta dilated, and exhibiting large masses of earthy matter on its internal surface.

2. *Partial dilatation (aneurisms).*—For specimens of partial dilatation, see Aneurisms.

Thrombosis.

Thrombosis, after chronic arteritis, is induced by the inequality and roughness of the internal surface of the artery, caused by the presence of the atheromatous ulcer or calcareous plates.

XIII. 160.—A portion of the right femoral artery of the patient from whom XII. 101, was taken. A few days before death he complained of acute pain and numbness in the right thigh. The temperature of the limb was at the same time considerably reduced. The artery is laid open to show a firm fibrinous plug filling up and obstructing the canal. The clot presented in different parts some slight differences of consistence and colour. The wall of the artery exhibited in some spots traces of atheromatous degeneration.

XIII. 101.—A femoral artery and vein. The femoral artery in its whole extent is rigid from calcareous degeneration of its coats. Its cavity is filled with a solid, firm, and partially laminated coagulum. The man from whom it was taken died of gangrene of the leg.

This plugging of the vessels of the lower extremities is a frequent cause of gangrene.

Embolism.

Embolism is another result of chronic arteritis. The emboli are composed of small portions of the broken-down fatty material which, after the internal coat covering the atheromatous patch has given way, become exposed to the current of blood, and are carried away and impacted in smaller vessels. The impaction of an embolus in an artery is a frequent cause of gangrene of the part which the vessel supplies. It is also a cause of aneurism, especially of the smaller arteries, the artery becoming dilated immediately behind the obstruction.

Gangrene.

Gangrene is a frequent result of atheroma. It has already been described how gangrene may be induced by thrombosis or embolism. Gangrene may, however, occur without any clotting, simply from the rigidity of the walls of the vessels, which renders them unable to adapt themselves to the varying demands of the part they supply.

PRIMARY CALCAREOUS DEGENERATION.

Primary calcareous degeneration must be carefully distinguished from the secondary calcareous change, which, as we have already seen, may occur in atheroma. The primary disease begins in the muscular layer of the middle coat; the secondary in the deeper layers of the intima. The primary chiefly affects the smaller vessels where muscular tissue is most abundant; the secondary the larger arteries, especially the aorta, where the elastic tissue predominates. In the primary the earthy matter is deposited in the muscular fibres of the middle coat in the form of a number of small rings; in the secondary it is deposited in the inflammatory new material, and

assumes the form of irregular bony plates. The primary is essentially a disease of old age; the secondary of the middle periods of life as well as of old age.

In the disease now under consideration the earthy matter is first deposited around the nuclei of the muscular fibres, but sooner or later involves the greater part of the muscular coat. It is most common in the arteries of the lower extremities, especially in the tibials. It is a frequent cause of senile gangrene.

XIII. 13.—Portions of the femoral, popliteal, tibial, and peroneal arteries, the coats of which, by the abundant deposit of earthy matter in them, form rigid bone-like tubes. The greater part of the deposit is in the form of narrow rings round the artery.

XIII. 80.—A femoral artery, the coats of which are made completely rigid by deposits of earthy substance. The deposits form a nearly uniform tube, in which, however, traces of an annular arrangement may be observed.

XIII. 89.—Femoral, popliteal, and tibial arteries, exhibiting abundant deposits of earthy matter in their coats. In some situations, especially in the posterior tibial artery, the earthy matter occupies the whole circumference of the vessel. Its general arrangement is in narrow rings.

From an aged man, in whom gangrene of the toes occurred spontaneously a short time before death.

XIII. 92.—Femoral, tibial, and peroneal arteries, in the coats of which there is an abundant deposit of earthy matter as in No. 89.

From an aged man, in whom mortification of the toes spontaneously occurred.

PRIMARY FATTY DEGENERATION.

Fatty, like calcareous degeneration, occurs as a primary change as well as secondary to chronic arteritis. As a primary change it begins in the endothelial lining of the arteries, to which it is usually confined, though in rare instances it may spread more deeply. It occurs in yellowish-white patches, slightly projecting into the interior of the vessel. These patches can be readily stripped off from the deeper layers, which, when thus exposed, are found healthy, whereas in chronic arteritis it is the deeper layers themselves which are the seat of the disease.

Although primary fatty degeneration generally affects the endothelial lining, it may occur in the case of the smaller arteries in the adventitia, or, in rare instances, in the middle coat.

XIII. 132.—The commencement of an aorta, exhibiting atheroma and fatty degeneration of the internal coat.

See also XIII. 112.

ANEURISM.

An aneurism has been defined as a tumour containing blood and communicating with an artery. (Holmes.)

STRUCTURE OF AN ANEURISM.

An aneurism consists of a sac and its contents.

The sac.

The sac may be formed by the dilatation of the whole circumference of a portion of an artery, and therefore consist of all three coats (fusiform aneurism or aneurismal dilatation) XIII. 15, or it may be formed by the dilatation of part only of the circumference of an artery, in which case it may consist of all the coats (true aneurism), XIII. 25, or of one coat only (false aneurism), XIII. 11; in the latter instance it is nearly always the external coat which becomes dilated, the internal and middle having given way; a rare form, where the internal coat is protruded through a rupture of the external and middle coats (the so-called hernia of the internal coat), is said by some to occur.

Again, the sac may be formed by the condensation of the surrounding soft parts, into which the blood has been extravasated in consequence of the rupture of all the coats of a vessel or of the sac of a previously formed aneurism (consecutive or diffused aneurism), XIII. 9, XIII. 24.

Or, again, the sac may be formed of the coats of the artery separated by blood which has been effused between them (dissecting aneurism), XIII. 33.

In the case of aneurismal varix (a so-called form of aneurism in which blood escapes from an artery into the cavity of a vein) the sac, if such can be said to exist, consists of a dilatation of a portion of a vein, XIII. 121.

The walls of the sac are generally thickened, atheromatous, and more or less blended with the tissues around.

XIII. 15.—An aneurism of the arch of the aorta. The sac is formed by the dilatation of the whole circumference of the aorta.

XIII. 25.—An aneurism of the arch of the aorta. The sac is formed by a partial dilatation of the artery, with integrity of all the coats.

XIII. 11.—An aneurism of the arch of the aorta. The sac is formed by the external coat alone.

XIII. 9.—An aneurism of the aorta. The sac is formed in part by the dilated aorta, and in part by the condensed tissues around.

XIII. 24.—Aneurism of the popliteal artery. The sac is formed entirely by the surrounding cellular tissue.

XIII. 33.—Aneurism of the abdominal aorta. The sac is formed by the separation of the walls of the aorta.

The contents of the sac.

When an aneurism is first formed the sac contains only fluid blood, or after death an ordinary blood coagulum; fibrine, however, is gradually deposited from the blood in concentric layers upon the internal surface of the sac, so that after an aneurism has existed some time the contents are partly solid laminated fibrine and partly fluid blood. The laminated fibrine next the wall of the sac is firm, dry, and of a yellowish-white colour, but gradually becomes softer, moister, and reddish towards the centre of the sac, while that next the fluid blood which still remains near the mouth of the sac merely resembles ordinary blood coagulum, and is probably the result of post-mortem coagulation. As will be seen under the head of spontaneous cure, this deposition of fibrine may continue until the whole sac is filled. In those instances in which an aneurism becomes solid in a few hours (the result of treatment or otherwise) it is probable that the greater part of the material filling the sac is merely blood coagulum, as in such instances the time would probably be too short for fibrine to be deposited. The subsequent stages in the organization of such a clot probably do not materially differ from those observed in the organization of clots in other situations. In fusiform aneurisms, in which there is but little retardation of the blood stream, deposits of laminated fibrine do not, as a rule, form, except there be much roughening of the walls from atheroma, and even then the deposits are but scanty.

XIII. 12.—Portion of an aneurismal sac, showing the laminated arrangement of the coagulum contained in it. See also XIII. 11.

XIII. 15.—A fusiform aneurism of the arch of the aorta. The sac contains no coagulum.

XIII. 130.—A fusiform aneurism of the ascending aorta. Over some of the rough atheromatous patches, seen on the internal surface of the sac, fibrine had been deposited and projected thread-like into the cavity of the sac. The fibrine was readily detached; it merely clung to the surface.

THE PROCESS OF FORMATION OF AN ANEURISM.

The process of formation of an aneurism will be explained under the head of *Varieties of Aneurism*.

METHODS OF SPONTANEOUS CURE.

I. *By the consolidation of the aneurism by the deposit of laminated coagulum from the blood in the interior of the sac.*

Specimens showing the deposit of laminated fibrine have already been seen. After the whole sac has been filled with such deposit, condensation and shrinking of the sac and its contents take place, and the aneurism becomes converted into a small nodular mass. Under such circumstances the artery may remain pervious, or it may be converted into a fibrous cord as far as the first collateral branches above and below the seat of the aneurism.

Such a favourable termination may be brought about by retardation of the blood-current induced:—1, by the lowering of the heart's action; 2, by the pressure of the aneurism on the artery above its opening into the sac; 3, by the partial blocking-up of the mouth of the sac by a portion of coagulum; 4, by the impaction of a clot in the artery below the mouth of the sac; 5, by the pressure of another aneurism or of some other tumour upon the artery above the mouth of the sac; 6, by the aneurism becoming diffused, the extravasated blood causing compression of the artery leading to the aneurism.

XIII. 11.—Sections of an aneurism of the arch of the aorta. The sac is nearly filled by laminated coagulum.

XIII. 7.—Sections of an aneurismal sac which was situated on the abdominal aorta, immediately below the superior mesenteric artery. The sac is completely filled by firm laminated coagulum.

XIII. 124.—An aneurism which has been spontaneously cured. The sac is filled with laminated coagulum.

The cure was brought about by the simple lowering of the heart's action and consequently of the force of the circulation through the sac—the result of rest in bed and low diet. The patient died of pleurisy four years after the cessation of pulsation in the aneurism. The heart was small and flabby, the walls of both ventricles had scarcely half their thickness.

XIII. 43.—A large aneurism of the common carotid artery. The sac is completely filled with laminated coagulum, probably in consequence of the slowing of the blood current from the pressure of the aneurism on the artery below the mouth of the sac. Notice the diminished calibre of the artery where pressed upon by the aneurism.

XIII. 69.—An aneurism of the upper part of the arch of the aorta, involving the innominate artery. A very firm and thick laminated coagulum lines the sac. A portion of coagulum was found detached and almost loose in the cavity of the aorta. It can easily be conceived how such a portion of coagulum might partially or completely have obliterated the mouth of the sac.

XIII. 75.—The remains of an aneurism of the right subclavian artery, which has been spontaneously cured.

On each side of the aneurism the artery is contracted and completely closed.

II. *By the coagulation of blood in the sac.*

The coagulation of blood in the sac, the passive clot, as it is sometimes called in contradistinction to the active clot (a name sometimes applied to the coagulum produced by the gradual deposition of laminated fibrine), may be brought about by the total cessation of the blood-current through the sac, induced (1) by the complete blocking up of the mouth of the sac by a portion of detached fibrine, or by (2) the complete plugging of the artery above or below the aneurism. The clot under favourable circumstances becomes organized and converted, like clots in other situations, into fibrous tissue.

XIII. 62.—An aneurism of the right common carotid and commencement of the internal and external carotid arteries. The sac is filled by a firm coagulum. This specimen well illustrates how an aneurism may be cured by the clotting of the blood in the sac consequent upon the complete arrest of the circulation through the artery. In this case, however, the arrest of blood did not occur spontaneously, but in consequence of the application of a ligature to the artery.

XIII. 166.—An aneurism of the popliteal artery. The artery below the aneurism was filled by a moderately firm plug, which was continuous with a firm discoloured clot in the mouth of the sac. The centre of the sac was full of dark coagulum (which has been washed out), but the walls were lined by laminated fibrine, that in the upper part being firm and tough, but that in the lower portion softer and almost diffuent.

III. *By inflammation and suppuration of the sac.*

The sac may become inflamed, and may afterwards suppurate and slough away, hæmorrhage being prevented by the formation of clots in the ends of the vessel, as in the separation of the slough in ordinary gangrene. Such a favourable termination is rare; more often fatal hæmorrhage supervenes on the separation of the slough.

No specimen.

FATAL TERMINATIONS.

An aneurism may terminate fatally—from rupture of the sac; from pressure upon important parts; from inflammation and suppuration of the sac; from gangrene caused by the obstruction to the circulation in consequence of the large size of the aneu-

rism, or of the plugging of a large vessel by a portion of detached coagulum; or from general constitutional disturbance.

I. *From rupture of the sac.*

Rupture of the sac, although here enumerated as one of the fatal terminations, is not in every case fatal; for, as we have seen, it may sometimes lead to a spontaneous cure, and in accessible aneurisms death, after rupture of the sac, may sometimes be averted by operative proceedings.

The manner in which the rupture occurs, and the various ways in which it proves fatal, differ according as the aneurism opens into a serous cavity, into a mucous canal, into the cavity of a joint, upon a cutaneous surface, or into the substance of the tissues.

Into a serous cavity.

The rupture in these cases is usually by a rent or fissure, and for the most part occurs suddenly.

Into the pericardium. XIII. 2.—An aorta with an aneurism of the first portion of the arch, which has burst into the pericardium. From a patient forty years old, who, while apparently in good health, died suddenly after a full meal. The pericardium was found distended with blood.

Death under such circumstances is caused by the impediment to the heart's action from the effused blood rather than by loss of blood.

Into the pleura. XIII. 9.—A heart with an aneurism extending from the commencement to the termination of the arch of the aorta. There is a small fissure on the side of the sac near its upper part, through which the blood escaped into the pleura.

In such a case death is usually the result of the actual loss of blood.

Into a mucous canal.

When an aneurism opens into a mucous canal, it is generally by a small round ulcerated orifice. Death may occur at once, or only after repeated hæmorrhages.

Into the trachea. XIII. 52.—The arch of an aorta with an aneurism at its upper and posterior part. The sac has compressed and burst into the trachea.

Into the œsophagus. XIII. 55.—The arch of an aorta from which an aneurism of the posterior wall has burst by a large ulcerated aperture into the œsophagus.

See also XIII. 58.

Into trachea and œsophagus. XIII. 54.—The arch of an aorta with a large aneurism. The sac has burst by two irregular apertures into the trachea and œsophagus.

Into a bronchus. XIII. 25.—The arch of an aorta, with a small aneurism rising from its termination, which has burst into the left bronchus.

Into the duodenum. XIII. 68.—An aneurism of the abdominal aorta, which has burst by a small, round, and regular ulcerated opening into the duodenum.

Upon a cutaneous surface.

Rupture upon a cutaneous surface is generally accomplished by sloughing of the integuments covering the sac. Death occurs only after repeated hæmorrhages, as the slough has at first a tendency to block up the aperture.

XIII. 26.—Iliac and femoral arteries, with an aneurism at the commencement of the femoral artery. Upon its lower part a portion of the skin is left with the aperture through which it burst externally.

XIII. 39.—Part of an aorta, with an aneurism at the commencement of the arch. The sac is extended forward through the sternum and ribs on each side, and, elevating the pectoral muscles, has formed a large tumour upon the breast. A portion of skin attached to the front of the tumour indicates by its white appearance that the process of sloughing has commenced at its centre.

Into an artery.

XIII. 15.—The arch of an aorta generally and almost uniformly dilated into a large aneurismal sac, which burst into the pulmonary artery. See also XIII. 87 and 102.

EFFECTS OF PRESSURE.

As an aneurism increases in size it gives rise to important symptoms, in consequence of the pressure which it exerts upon the tissues around; these symptoms serve as a valuable guide to the diagnosis and prognosis of the disease.

These effects of pressure, as far as they are illustrated in the Museum, will be discussed under the following heads:

Upon the bones and cartilages.

The bones and cartilages become eroded, and in the case of the sternum and ribs frequently perforated.

Upon the vertebræ. XIII. 58.—The arch of an aorta, with an aneurism of the third part. The pressure of the aneurism has caused absorption of the bodies of several of the vertebræ. It may be noted that the intervertebral cartilages are but little affected, as is usual in these cases.

See also I. 55 and I. 156.

Upon sternum and costal cartilages. XIII. 10.—An aneurism, which has caused absorption of part of the sternum and costal cartilages, and has projected through the aperture thus formed in the thoracic walls.

See also XIII. 70.

XIII. 48.—Part of an abdominal aorta with a large aneurism, which has extended from its posterior wall backwards through the vertebræ and ribs, and forms a large sac external to the chest by the side of the spine.

Upon blood-vessels.

Pressure upon the veins frequently leads to the formation of clots in their interior, and consequently to cedema of the parts from which they return the venous blood, to dilatation of the superficial veins, or, in the case of accessible aneurism, where the arterial supply is also interfered with, to gangrene of the limb.

It has already been seen how the pressure of an aneurism upon an artery, either above or below the mouth of the sac, may lead to the spontaneous cure of the aneurism.

XIII. 83.—A femoral artery, the seat of aneurism. The femoral vein to the extent of two inches is obliterated by the pressure of the aneurism.

XIII. 2.—An aorta, with an aneurism of the first part of the arch compressing the pulmonary artery.

Upon nerves.

The pressure of an aneurism upon nerves is often productive of severe pain, and frequently seriously interferes with the functions of the parts which the nerves supply. A good illustration of this is the alteration or loss of voice from paralysis of the muscles of the larynx, in consequence of the pressure of an aneurism upon the recurrent laryngeal nerve.

XIII. 62.—An aneurism of the right common carotid. Portions of the pneumogastric and sympathetic nerve are flattened and compressed by the aneurism.

XIII. 125.—The arch of an aorta with its branches, with an aneurism of the arteria innominata. The pneumogastric trunk and its recurrent branch are closely adherent to the exterior of the aneurismal sac; and the former was much compressed between it and the clavicle.

Upon trachea, bronchi, and lungs.

Pressure on these important structures may give rise to dyspnœa, cough, or other symptoms of pulmonary irritation.

XIII. 18.—An aneurism of the arteria innominata, pressing upon the trachea. The patient, a fortnight before death, was subjected to paroxysms of dyspnœa, in one of which he died.

XIII. 69.—An aneurism of the aorta and innominate artery pressing upon the trachea. The pressure upon the trachea gave rise to symp-

toms of asthma. The symptoms increased to such a degree that the trachea was opened to prevent suffocation, which seemed impending.

XIII. 39.—Part of an aorta with an aneurism at the commencement of the arch. The sac in its progress towards the sternum has extended on each side into the lungs.

Upon the œsophagus and thoracic duct.

Pressure upon the œsophagus or thoracic duct is occasionally fatal, in the one case from the inability to swallow food, and in the other from the obstruction to the passage of the chyle into the blood.

XIII. 58.—A large aneurism of the thoracic aorta compressing the œsophagus.

EFFECTS OF TREATMENT.

By rest and low diet.

XIII. 124.—The arch of an aorta, with a very large aneurism projecting through the front of the chest. With the exception of a small part immediately adjacent to its mouth, the whole cavity of the aneurism appears filled with tough, and for the most part firmly compacted, layers of decolorised blood-clot.

The patient, a publican, æt. 47, had suffered for a year with well-marked symptoms of aneurism of the aorta. He kept his bed, and took only small quantities of light food, but the swelling, dyspnoea, venous congestion, and other distresses still increased. At the end of a few months the disease apparently ceased to make progress; the external swelling did not enlarge, it slowly became firmer, its pulsations diminished in force, until they became scarcely perceptible. The patient during this time became pale, emaciated, and very feeble, needing better diet and stimuli. He had kept his bed for six months, but now moved about in a chair. Improvement still continuing the tumour became, at length, pulseless, hard and incompressible. In this state he lived for more than two years, when, after exposure to excitement and less prudent living, he died with suppurative pleuritis.

By ligature of the artery leading to the aneurism.

XIII. 21.—Aneurism of the axillary artery, for the cure of which the subclavian artery has been tied. The portion of artery between the situation of the ligature and the aneurismal sac is completely closed by coagulum. The aneurismal sac is also in great part filled by laminated coagulum. The axillary artery from the point of its connection with the sac is quite pervious.

XIII. 26.—An aneurism at the commencement of the femoral artery, for the cure of which the external iliac was tied fifty-five hours before death.

XIII. 27.—An aneurism at the commencement of the femoral artery,

for the cure of which the external iliac has been tied. Within that part of the artery which is directly above the sac is a small conical clot completely filling its canal.

XIII. 86.—An aneurism of the popliteal artery, for the cure of which the femoral was tied three weeks before death.

XIII. 114.—A popliteal aneurism, for the cure of which the femoral artery was tied eighteen months before death. The aneurism was diminishing at the time of the patient's death. The femoral artery is completely obliterated from the situation of the ligature to the origin of the profunda, and in part converted into a fibrous cord. Below the obliterated part of the artery a rust-coloured clot of blood extends for half an inch, and is continued as a thin fibrinous layer lining the whole length of the rest of the artery down to the aneurismal sac. The sac and its mouth are completely filled with dry laminated coagulum.

By pressure upon the artery leading to the aneurism.

XIII. 189.—Aneurism of the left femoral artery, which was treated by the method of compression. On passing a stream of water, under slight pressure, into the artery from above, none appeared to escape from the lower end; and it was evident, on further examination of the clot contained in the aneurism, that it was sufficiently firm to have prevented the current of blood through it.

By flexion of the affected limb.

XIII. 185.—Aneurism of the popliteal artery filled with recent laminated fibrine. The aneurism had been treated by flexion of the patient's limb upon the trunk, and all pulsation in the sac ceased. Four hours after the limb had been returned to the horizontal posture, symptoms supposed to be those of gangrene made their appearance, and amputation through the thigh was performed. The patient made a good recovery.

VARIETIES OF ANEURISM.

The various aneurisms contained in the Museum are here classified as in Holmes' 'System of Surgery.'

I. SPONTANEOUS ANEURISMS.

A. Common or encysted, subdivided into—

1. Fusiform.
2. True.
3. False.
4. Consecutive.

B. Arterio-venous.

1. Aneurismal varix.
2. Varicose aneurism.

C. Cirroid.

D. Dissecting.

II. TRAUMATIC ANEURISM.

A. Traumatic or circumscribed traumatic aneurism.

B. Diffused traumatic aneurism or ruptured artery.

These so-called traumatic aneurisms are described under Injuries of the Arteries.

A. COMMON OR ENCYSTED ANEURISM.

By common or encysted aneurism is meant that variety of the disease in which "a tumour is formed of a single cyst, communicates only with a single artery, and is limited to a single point in the course of that artery" (Holmes).

The following are the subdivisions of encysted aneurism.

1. FUSIFORM ANEURISM OR ANEURISMAL DILATATION.

A fusiform aneurism is a dilatation of the whole circumference of a portion of an artery. The sac, therefore, consists of all three arterial coats, and its cavity is continuous with the lumen of the artery at each end. The dilated portion of the artery is also elongated, a fact well shown in fusiform aneurism of the arch of the aorta, where the three primary branches given off from the convexity of the arch are much further apart than is natural.

Fusiform aneurisms are of an elongated, fusiform, or cylindrical shape; they often attain a large size, are usually chronic, and after they have existed some time frequently become sacculated from the unequal yielding of their walls. They seldom contain any laminated fibrine, as the circulation through them is not, as a rule, sufficiently retarded to allow of its deposition. The walls of the sac are sometimes thinned, but more often thickened and highly atheromatous.

The favourite seats of these aneurisms are on the arteries that contain much yellow elastic tissue, hence they are most often met with on the aorta and its primary branches, and on the contiguous portions of the iliac and femoral arteries.

XIII. 15.—The arch of the aorta generally and almost uniformly dilated into a large aneurismal sac. The interior of the sac is very unevenly tuberculated; it contains no coagulum.

XIII. 18.—An aneurism of the innominate artery. The sac appears to be formed by dilatation of the whole circumference of a part of the artery, and contains laminated coagulum.

XIII. 47.—A fusiform aneurism of the popliteal artery—an uncommon situation for this variety of aneurism.

2. TRUE ANEURISM.

A "true aneurism" is a dilatation and growth of a portion of an artery in part only of its circumference, with integrity of all the coats. True aneurisms are usually of a globular, sac-like form; they are always of small size and communicate with the artery by a large mouth. When a true aneurism is first formed the three coats can be distinctly traced in the walls of the sac, but as it increases in size one or more of the coats give way, and a false aneurism is produced. The occurrence of true aneurism, except in the arch of the aorta, has been denied, as it is maintained that the presence of all three coats in aneurisms in other situations cannot be demonstrated. XIII. 50, however, is an undoubted specimen of a true aneurism of the renal artery.

The presence of a smooth lining membrane to the sac is not a proof that the internal coat is present, and hence that the aneurism is of the true variety.

Of the arch of the aorta, (the common seat.)

XIII. 25.—The arch of an aorta, with a small aneurism arising from its termination.

XIII. 102.—The arch of an aorta, with its great branches and the pulmonary artery. The whole of the arch is somewhat dilated. A small aneurismal pouch involving all the coats extends from the aorta just above the right semilunar valve.

XIII. 132.—The commencement of an aorta, with part of the pulmonary artery and of the right and left ventricles. A true aneurism projects from the aorta into the right ventricle, and two others are seen in different stages of formation.

Of the abdominal aorta.

XIII. 16.—A true (?) aneurism springing from the posterior wall of the abdominal aorta. The internal coat of the artery appears continuous throughout the aneurism.

Of the renal artery.

XIII. 50.—True aneurism of the renal artery.

3. FALSE ANEURISM.

A false aneurism is a dilatation of part of the circumference of an artery, with partial destruction of the coats. The false aneurism is formed either by the giving way of the internal and middle coats of a previously formed true aneurism, or by the primary destruction of the internal and middle coats of an artery by atheroma, &c., and the expansion of the external coat by the pressure of the blood. The

expanded external coat becomes thickened by inflammation and the adhesion to it of the soft tissues around. A false may generally be distinguished from a true aneurism by its larger size, by the internal and middle coats of the vessel terminating abruptly at the mouth of the sac, and by the much smaller size of the mouth in proportion to the size of the sac.

XIII. 7.—Sections of a false aneurism of the upper part of the abdominal aorta. The abrupt ending of the internal and middle coats of the vessel at the mouth of the sac is well seen.

XIII. 11.—A false aneurism of the second portion of the arch of an aorta. The abrupt ending of the internal and middle coats at the mouth of the sac is well seen.

It was formerly taught that another variety of false aneurism, the so-called hernia of the internal coat, might arise in consequence of rupture of the external and middle coats and the protrusion of the internal coat in the form of a pouch through the rent. The occurrence of such a variety is now doubted.

There is no specimen in the Museum.

4. CONSECUTIVE OR DIFFUSED ANEURISM.

A consecutive or diffused aneurism is one in which "all the coats have given way, the sac being formed out of neighbouring parts" (Holmes). It is produced either by the giving way of the sac of a previously formed aneurism, or by the rupture of all the coats of an artery. It is probable that all aneurisms assume this form after they have existed some time. This variety corresponds with what is called by Mr. Erichsen a "diffused false sacculated aneurism."

XIII. 9.—A consecutive aneurism of the arch of the aorta. The sac is of immense size. The lower part is formed by the dilated aorta, but at its upper part its walls are formed by condensed cellular tissue, the original walls of the sac having given way in this situation.

XIII. 24.—A popliteal artery with diffused aneurism. There appears to have been a complete rupture of all the coats of the artery, so that the sac is formed of condensed cellular tissue. The coats of the artery terminate abruptly at the boundaries of the sac.

XIII. 166.—Aneurism of the right popliteal artery. The arterial coat seems to terminate abruptly, and cannot be traced as the aneurismal sac. This was principally formed of thickened cellular tissue and expanded muscle, but in one place the skin only bounded it, and in others it seemed to have consisted only of fascia. The popliteal nerve was tightly stretched over the sac, rendering it in a measure bi-lobed.

B. ARTERIO-VEINUS ANEURISM.

Under this head two forms of aneurismal dilatation, resulting from a communication between an artery and a vein, are generally described—aneurismal varix and varicose aneurism. In both there is an aneurismal dilatation of the vein produced by the entrance of arterial blood into it, but in the former the blood passes directly into the vein, in the latter indirectly into the vein through the sac of an aneurism interposed between the artery and vein.

ANEURISMAL VARIX.

Aneurismal varix may occur spontaneously, or as the result of a penetrating wound implicating both artery and vein. It was common when venesection was practised. The external wound heals, the adjacent walls of the two vessels become adherent, and, the opening between them remaining patent, arterial blood is forcibly projected into the vein, causing its walls to become dilated into a fusiform or sac-like swelling. The artery on the cardiac side becomes greatly dilated from the impediment to the circulation, whilst the distal portion generally becomes smaller in consequence of less blood passing through it.

XIII. 121.—Portion of a left petrous bone, with which are connected the left carotid arteries and other adjacent parts. The external carotid is large from its origin; and just after giving off its lingual branch it becomes thin-walled, much larger, and very tortuous. Its canal, from this point to its final division, is nearly half an inch in diameter and about two inches in length. At the upper part of this, its tortuous and dilated portion, there is an aperture of communication between the external carotid artery and the upper part of the internal jugular vein, the vessels being brought into unnatural proximity at one of the curves of the artery. The aperture (through which a bristle is passed) is oval and nearly two lines in chief diameter.

On the wall of the vein, immediately opposite to this aperture and about three quarters of an inch below the jugular fossa, a brownish discolouration appears beneath the lining membrane; it is due to the rust of a wedge-shaped piece of iron there embedded. The piece of iron is exposed on the other side by laying open a cavity in which it lies, with all the surrounding tissues closely applied to it and blackened by its rust and little particles of soil.

The patient was a middle-aged man, and his death was independent of the injury here shown. The injury was received twelve years before death. The piece of iron, broken from the point of a pick-axe, penetrated through the side of the neck. Severe hæmorrhage ensued, but the wound healed without difficulty. A loud whizzing sound and strong vibration were always perceptible over the swelling produced by the dilated artery.

VARICOSE ANEURISM.

A varicose aneurism may occur spontaneously from the opening of the sac of an ordinary aneurism into a vein, or it may be the result of a penetrating wound implicating both artery and vein. In the latter case the external wound heals, whilst the soft parts between the artery and vein are converted into the sac of an aneurism. The blood before reaching the vein has therefore to pass through the aneurism, and hence causes less dilatation of the vein than when the communication is direct. The artery is not necessarily dilated.

XIII. 91.—A spontaneous varicose aneurism of the femoral artery and vein. The aneurism is situated on the artery just before its passage through the adductor magnus. It is a small globular sac, formed by dilatation of the whole circumference of the artery, and communicates directly with the femoral vein. The interior of the vein presents a rounded opening, with thin and smooth edges, about a quarter of an inch in diameter. Around this opening the vein is closely united to the aneurism, and immediately below it the cavity of the vein is obliterated to the extent of half an inch. A ligature had been placed around the femoral artery about a week before death. The whole length of the artery is uniformly dilated to the size of an abdominal artery, and its coats are very thin.

The patient was a man forty-seven years old. The most striking sign of the disease was a peculiar purring thrill, which was felt along the whole course of the femoral artery, both during its pulsations and in the intervals between them, but which could be stopped by pressure on the varicose aneurism. Long-continued pressure on this part produced, it was believed, the obliteration of the vein about six months before the patient's death.

XIII. 84.—The arch of an aorta, exhibiting an aneurism which has opened into the vena cava superior. The vein is adherent to the exterior of the sac, and there is an aperture of communication between them, immediately around which aperture the vein and the sides of the sac are so attenuated as to be transparent.

C. CIRROID ANEURISM.

"Cirroid aneurism" is the name given to a convoluted and dilated condition of an artery. It is called arterial varix by Mr. Erichsen. There is no specimen of this rare condition of the arteries in the Museum.

D. DISSECTING ANEURISM.

A dissecting aneurism is one in which the internal coat of the

artery has given way, and blood has been forced between the layers of the middle coat for a variable distance parallel to the course of the artery. It is most frequent in the arch and thoracic portion of the aorta. Three forms are described—

1. That in which the blood, after travelling a variable distance between the layers of the middle coat in the course of the artery, escapes into the tissues around the vessel, in consequence of the giving way of the external coat and the outer layers of the middle coat.

XIII. 110.—Part of the heart with the aorta. A transverse rent extends through the inner coat and innermost layers of the middle coat. Blood has been forced through the rent, and has thence extended and separated the layers of the middle coat through a large portion of the arch and thoracic portion of the aorta. The external coat, at a spot not shown in the preparation, has given way, and the pericardium was found distended with about two pints of blood.

The patient was a woman, aged forty-five, who, as she was carrying two pails of water, suddenly fell down and almost instantly expired.

XIII. 113.—Parts of a heart and aorta exhibiting a transverse rent extending round the whole circumference of the inner and middle coats of the aorta, about half an inch above the valves. The characters of this specimen closely resemble those of XIII. 110. The torn coats are soft, but in other respects they appear healthy.

The patient was a man about twenty-five years old. He had delicate health, but was not supposed to have any disease of the heart. He was suddenly seized, while walking, with pain in the chest and faintness and quickly died.

2. That in which the blood, after travelling some distance in the course of the artery between the layers of the middle coat, has again made its way into the interior of the artery in consequence of the giving way of the internal coat and the innermost layers of the middle coat.

No specimen.

3. That in which the blood has made its way a variable distance between the layers of the middle coat in the course of the vessel, but has escaped neither externally nor internally.

XIII. 111.—The base of a heart, with the arch and thoracic portion of the aorta. About half an inch above the valves there is a rent extending through the inner coat and innermost layers of the middle coat of the aorta. The blood passing through it has extended between the layers of the middle coat through the whole length and greater part of the circumference of the aorta, separating them and tearing across the intercostal and other small arteries. Some of the blood, coagulated, remains in the channel which it has formed for itself between the coats of the artery.

XIII. 112.—The abdominal aorta of the same patient, showing the further separation of its coats by the effused blood.

XIII. 33.—Sections of an abdominal aorta with a small dissecting aneurism. The sac is situated between the coats of the artery, its cavity extending on every side of the small mouth by which it opens through the inner coat. Its cavity is completely filled with laminated coagulum.

INJURIES AND DISEASES OF THE VEINS.

WOUNDS.

Extensive wounds of the large veins are fatal, but, owing to the decreased blood pressure in these channels, less immediately so than wounds of arteries. Indeed, cases are reported of patients surviving several hours after rupture of the subclavian vein, and even after rupture of the vena cava superior.

Punctured or incised wounds, when small and parallel to the long axis, even of large veins, readily heal; a clot of blood forms within the wound and projects slightly into the lumen of the vessel, while externally it overhangs the walls of the veins around the wound. The clot becomes organized and converted into fibrous tissue, leaving a distinct cicatrix in the walls of the vein. In the majority of cases healing thus takes place without obliteration of the lumen of the vein; in other instances, however, successive layers of fibrine are deposited upon the clot projecting into the interior of the vein, so as completely to fill the vessel. Under the latter circumstances the clot may become organized and converted, together with the vein in which it is contained, into a fibrous cord, or it may break down into pus (suppurative phlebitis). Occasionally the lips of the wound, when kept in apposition, unite by adhesive inflammation without the interposition of a clot. Such a result was often noticed after venesection, no trace of the wound being visible even on the smooth lining membrane.

When a vein is completely cut across, as in amputation, a clot forms, extending from the divided end to the next collateral branch above, and, becoming organized, leads to the occlusion of the vein, as already described. When a vein is completely cut across in an incised, or other wound, a clot forms in the lower as well as in the upper end, occluding the vein in a similar manner.

After the application of a ligature healing occurs in a vein, in the same manner as in an artery. It is no longer believed that the application of a ligature induces suppurative phlebitis. When the edges of a small wound in the continuity of a vein are secured by a

ligature (a method of arresting hæmorrhage frequently resorted to by surgeons in preference to tying the whole circumference of the vessel), healing takes place without obliteration of the lumen of the vein.

XIII. 71.—Portion of a vena cava inferior, in which there is a transverse lacerated aperture, about two inches above the iliac veins.

XIII. 38.—Parts of a femoral artery and vein from a stump. The extremities of the artery and vein are closed. Both of them have coagula above their closed extremities.

XIII. 65.—A posterior tibial artery and vein, which were wounded a few days before death. The wound is transverse and extends through only one side of each vessel. The clot of blood seen in the preparation was found adhering to both vessels. The regularly circumscribed cavity in it was exactly over the division of their coats.

PHLEBITIS.

Two conditions of the veins, the one characterized by the formation of clots in their interior, the other by the presence of pus within and around them, have long been described and have received the names of adhesive and suppurative phlebitis respectively, on the supposition that both were dependent upon inflammation beginning in the walls of the veins themselves. Many observers, however, at the present day maintain that the so-called adhesive phlebitis is due simply to the clotting of the blood in the interior of the vein, and is entirely unaccompanied by inflammation, or at the most, is attended by slight inflammatory thickening of the vein-walls as an after-result; and that the so-called suppurative phlebitis is nothing more than a phlegmonous inflammation tracking up the connective tissue around the vein, of which the suppuration in the interior of the vein is the consequence. They have, therefore, proposed that the term phlebitis should be discarded as misleading, that clotting of the blood in the veins should be called thrombosis, and that the phlegmonous inflammation around the veins should be classed with other phlegmonous inflammations. As the term phlebitis, however, is still used in many text-books, it has been thought better to retain it.

ADHESIVE PHLEBITIS.

This disease was formerly described as an inflammation beginning in the internal and middle coats of the veins. It was said that, first, the lining membrane appeared dark red, then covered with an exudation of lymph, and that, finally, clots appeared in the interior of the veins as a consequence of the roughening of the lining membrane by the inflammation. Further researches, however, have shown

that these appearances may be produced by the primary formation of coagula; that these coagula are often unaccompanied by any inflammation whatever; and that in those cases where inflammation undoubtedly does occur, it occurs as the result and not as the cause of the clotting.

It is probable that the redness ascribed by the older authors to inflammation was merely post-mortem staining by the colouring matter of the blood, and that the deposit of lymph was either a deposit of fibrine from the blood upon the lining membrane, or lymph which had made its way into the vein from the exterior through a hole in the vein communicating with an open wound. That the lining membrane is not susceptible of inflammation, even when exposed to irritants, is shown by the experiments of Mr. Callender (see the following specimens).

XIII. 159.—Four specimens, showing certain changes in veins. The two upper represent (a) an external circumflex vein occupied by a pale, fawn-coloured coagulum, which shows a spiral arrangement of the fibrine which forms it; (b) the femoral vein of a dog, part of which, included between two ligatures, had been punctured during life, the blood which it contained removed, and two small pieces of lead introduced. Twenty-four hours after the operation the vein was examined and found surrounded by a quantity of lymph, a considerable amount of which had entered the vein through the puncture, distending the vessel as seen in the preparation.

The two lower represent: (a) part of the femoral vein of a dog upon which an experiment was performed resembling the preceding, but the upper ligature was shifted so as to cut off the portion of a vein in which the bits of lead were included from communication through the puncture in its walls with the outer wound. The portion of vein (thus isolated) is laid open, showing an unaltered condition of its lining membrane twenty-four hours after the operation. Its canal was free from exudation material, and the bits of lead lay in simple contact with the vein wall.

(b) Part of the femoral vein of a dog, into which a small piece of lead had been introduced, suspended from a thread, as seen in the preparation. The blood was then allowed to flow through the vessel for twenty-four hours, at the end of which time the lining membrane of the vein retained its natural appearance.

Regarding, then, the disease as primarily a clotting of blood in the veins (Thrombosis), the *causes* that produce the clotting will first be considered.

Causes of the clotting.

A predisposition to clotting is induced by weakened cardiac power and slowing of the circulation, such as occur in exhaustion following upon acute and chronic diseases; and possibly by excess

of fibrinogenous material in the blood. Clotting is common in patients dying of phthisis or cancer, and, as pointed out by Sir James Paget, in persons of marked gouty constitutions, or with gouty inheritance.

The exciting causes of the clotting may be enumerated as—

1. *Pressure*.—Pressure upon a vein is a frequent cause of thrombosis. When the pressure is sufficient to completely obliterate the vein-channel a clot forms above and below the seat of obstruction, as after the application of a ligature; but when the pressure is slight and only partially obstructs the flow of blood the coagula are more extensive, and generally occur in the veins *below* the narrowed portion (where the blood stream is retarded).

XIII. 157.—Part of an external saphenous vein, obliterated by clots in consequence of slight pressure produced by a cancerous growth involving the lower part of the femur.

XIII. 17.—Parts of an abdominal aorta and of the vena cava inferior. Both vessels are embedded in a mass of enlarged lymphatic glands. The vena cava, to the extent of three inches above the iliac veins, is completely filled with concentric layers of fibrine, which are adherent to its inner surface.

XIII. 53.—A popliteal artery, with part of a large aneurismal sac. The upper portion of the popliteal vein is obliterated in consequence of the pressure of the aneurism; the lower portion is pervious.

XIII. 83.—A femoral artery, the seat of aneurism. The femoral vein, to the extent of two inches, is obliterated by the pressure of the aneurism. Below the obliterated part the vein is laid open to show the clots of fibrine filling its cavity.

XIII. 26.—An aneurism of the femoral artery. The femoral vein is open above and below the sac, but is obliterated by the pressure of the sac in the mid-space.

XIII. 163.—A portion of the common iliac and of the external and internal iliac veins of a man aged thirty-five. Five weeks before his death he was admitted into the hospital with phlegmonous erysipelas of the right leg and thigh. Profuse suppuration occurred, and he appeared to be rapidly recovering, when pneumonia suddenly supervened, and he died ten days afterwards. Four days before his death the left leg and thigh became œdematous. The portions of the vein in the preparation are completely filled up by large clots, which extended to Poupart's ligament. The clots were firm and partly decolorised. Similar clots filled up the neighbouring smaller veins. The clot in the femoral vein below Poupart's ligament was in great measure disintegrated.

XIII. 29.—This preparation consists of the remains of the vena cava, the right kidney, and a firm fleshy tumour which has been formed between them. The vena cava is obliterated from its bifurcation almost to its termination in the auricle. The upper part of the vein is distended by fibrous substance, which appeared to have been

separated from the blood. Below this the vein could not be traced; it appeared to be completely lost in the diseased structure.

XIII. 27.—Iliac and femoral arteries and external iliac vein, with an aneurism at the commencement of the femoral artery. The external iliac vein is pervious to within an inch of the sac, but there it is obliterated by the pressure of an aneurism.

2. *Inflammatory changes of the tissues around.*—Inflammation, ulceration, and gangrene of the tissues surrounding a vein, in consequence of the alteration they produce in the vein-walls, are frequent causes of thrombosis.

XIII. 61.—A femoral artery and vein, which were exposed and partly destroyed in the progress of a phagedænic ulcer. A portion of the vein is obliterated, and its cavity below the obliterated part is filled by a clot of blood. The disease extended from the labia of a woman, and destroyed a large portion of the perineum before it reached the groin.

XIII. 150.—A right common iliac vein, with the termination of the left and of the right internal and external iliacs, containing coagula. From a man who died with chronic inflammation of the contents of the pelvis.

XIII. 101.—A femoral artery and vein, from a man in whom, in advanced life, gangrene of the leg spontaneously arose several months before death, and extended high up the leg. The coats of the femoral vein are thickened; portions of it are filled by firm coagulum.

3. *Wounds.*—Thrombosis is a frequent result of wounds, lacerations, and bruises of veins. As illustrations may be mentioned the coagula found in the veins after amputation, or occasionally after venesection, in the veins about the seat of severe compound fracture, or, again, in the veins of the pelvis and lower extremities after parturition, where they occur in consequence of the laceration of the vessels in the separation of the placenta.

XIII. 35.—Parts of a femoral artery and vein from a stump. The extremity of the vein is closed by a conical clot, similar but smaller than that in the artery. The coats of the artery and vein are thickened and closely united to the surrounding parts.

XIII. 135.—A femoral vein, from the junction of the profunda to an inch above the canal of Hunter, occupied by a conical clot. The tissues around are extensively ecchymosed, and all the smaller veins are filled by fibrinous clots, apparently of older date than that which fills the femoral.

From the body of a feeble old man, who died three weeks after sustaining a fracture of the neck of the left femur. The muscles and other tissues of the upper part of the thigh were the seat of extreme ecchymoses.

XIII. 140.—A preparation, in many respects similar to No. 135. The clot which fills the femoral vein is tough, firm, and decolourized. The vessel is surrounded below by some ecchymosed tissues, and here

the small venous branches are occluded by old clots, continuous with the large one seen in the femoral.

From a man, aged seventy-three, who died from bronchitis eleven days after sustaining a fracture of the left femur at its great trochanter. There was great ecchymosis of all the parts around, especially in the vicinity of the femoral vessels. The leg and foot were slightly oedematous.

XIII. 158.—Part of a femoral vein where joined by the profunda. The latter vessel is obstructed with firm clots, which extend up into the femoral, forming in its interior an irregular mass of a pale colour. The coagula in the profunda were traced to a considerable ecchymosis, which involved the structures about a fracture of the right femur, more especially in the inner and posterior aspect of the thigh. The entire extremity was oedematous. The fracture, which had occurred ten weeks prior to the patient's death, was still ununited.

The patient was a man, aged forty-two, who died from an attack of continued fever.

XIII. 128.—The left common iliac, the external iliac, part of the femoral, and of the adjacent veins, irregularly distended and their canal completely obliterated by firm clots, from a woman who suffered from much obscure pain about the pelvis and groin after a protracted labour.

4. *Growths into veins.*—Growths invading the lumen of a vein, by destroying the smoothness of the lining membrane, induce coagulation.

XIII. 103.—The base of a heart, with the large vessels, the trachea, and the bronchial glands. The whole of the bronchial glands are converted into one large mass of cancer which surrounds and compresses the pulmonary arteries and veins and the vena cava superior. Both the venæ innominatæ are also pressed upon by the upper part of the diseased mass. The vena cava superior is so much compressed that its canal would scarcely admit more than the bristle which is passed through it. At the junction of the venæ innominatæ the cancerous structure appears to have made its way into the cavity of the vein. Near the junction of the right subclavian and internal jugular veins, beneath the valve, there is a small growth from the interior of the vein, the structure of which appears to resemble that of a large tumour.

XIII. 96.—Portion of the ovarian vein, from a woman in whom there was extensive medullary disease of the uterus and adjacent parts. The vein is dilated and filled by fibrinous coagulum deposited in concentric layers.

5. *Inflammation of the walls of veins.*—In rare instances the clotting may be the result of inflammation in the deeper layers of the intima (those next the middle coat), though never of the lining membrane, as formerly taught. This inflammatory change has

some resemblance to the inflammatory condition called atheroma, already described as occurring in the arteries.

No specimen.

6. *The application of a ligature to a vein.*—After the application of a ligature, a clot forms in the vein as far as the next collateral branch, and, in the usual course of events, becomes organized, and is ultimately converted, together with the portion of vein in which it is contained, into a fibrous cord.

XIII. 147.—Part of the femoral vein of a dog, which was killed ninety-six hours after the injection of twenty drops of pus. The ligature has separated, and the vein is obliterated where it has been tied. Its internal coat presents a natural aspect.

XIII. 148.—A similar specimen, in which three ligatures were applied to the vein. They have separated, and the portion of vessel included between the ligatures is destroyed.

The last two specimens were prepared by Mr. Callender.

7. *Without apparent exciting cause.* XIII. 172.—A femoral vein from a man aged forty-two. It is filled with blood, which coagulated in it a few days before death. The same condition was presented by all the veins of both arms and legs. The patient's illness, which was ascribed to phlebitis, began three weeks before death.

Extension of the clot.

The clot, once formed, may extend either with or against the stream of the blood; as a rule it follows the former direction, extending from the smaller to the larger veins, till in extreme cases it may even reach the heart.

Against the stream. XIII. 150.—A right common iliac vein, with the termination of the left and of the right, internal and external iliacs. They are opened on their posterior surface so as to expose the coagula within. One of these occupies the external iliac, and was thence continued into the femoral. It is firm and contracted, everywhere in contact with the shrunken vein-wall, the outer coat of which and the surrounding tissues are thickened. This coagulum ends at the junction of the internal iliac, above which is a larger clot. From a man who died with chronic inflammation of the contents of the pelvis.

XIII. 128.—The left common iliac, the external iliac, part of the femoral, and of the adjacent veins, completely obliterated by firm clots, clinging, not adhering, to the inner coats of the vessels. Traced from below, these clots are arranged in successive layers, fitting cup-like one upon the other, terminating above in a pointed extremity. The veins opening into the main trunks are obliterated to some extent by coagula continuous with those already described. Both sides were equally affected. From a woman who suffered from much obscure pain about the pelvis and groins after a protracted labour.

With the stream. XIII. 135.—A femoral vein, from the junction of the profunda to an inch above the canal of Hunter. Its canal is occupied by a conical clot, which retains the colour and the appearance noticed in its recent state. The clot clung, but did not adhere, to the lining of the vein, and was further retained in its position by its connection with other clots, which filled all the communicating branches.

The tissues around were extensively ecchymosed, and all the smaller veins were filled by fibrinous clots, more or less decolourized, and apparently of older date than that which fills the femoral.

Appearances of the clot.

The appearance of the clot depends upon its age, its situation, and the manner in which it has been formed. When recent the clot is red and gelatinous, and but slightly adherent to the vein-walls, but after it has existed some time it loses its red colour, and becomes firmer and shrunken.

When suddenly formed it fills the whole vessel, and has a uniform consistence throughout; when slowly formed it is laminated, and may or may not fill the vessel, according to the time it has been in process of formation; this lamination is the result of the deposition of alternate layers of fibrine and white blood-corpuscles. When produced in a vessel round which a ligature has been applied near a collateral branch, the clot may be colourless from the first, and of a curious spiral shape—a result, according to Mr. Callender, of a churning movement of the blood, which he believes to take place in that portion of vein included between the ligature and the first collateral branch. The clot is usually of a conical shape, with either a pointed or a blunt extremity, according as it is formed within, or only projects into, a large vessel.

These appearances must be distinguished from those observed in clots which form after death. A post-mortem clot does not adhere to the walls of the vessel, nor does it, as a rule, entirely fill up the cavity; it often consists of two layers, one white and one red, but is never laminated.

XIII. 135.—A recent clot, of a conical shape, occupying the femoral vein. It terminates above where a large vein enters the femoral, and here its shape seems to have been influenced by the current of blood directed upon its surface.

XIII. 127.—The primary branches of a portal vein. One proceeding to the right lobe of the liver is occupied by a firm decolourized clot, which clings to the adjacent walls, but is not adherent to them. The wall is wrinkled transversely.

XIII. 128.—The clots in this preparation, traced from below, are arranged in successive layers, fitting cup-like one upon the other, ter-

minating above in a pointed extremity—a mode of termination seen in a clot suspended separately which was removed from the right common iliac vein.

XIII. 108.—Two coagula of blood, which were found attached to the inside of one of the veins of Specimen XIII. 107. The section of the left-hand coagulum shows that it consists of regularly arranged layers of fibrine.

XIII. 17. See the concentric arrangement of the fibrine forming the clot in this specimen.

Changes in the clot.

I. The clot may become organized and converted, with that portion of vein in which it is contained, into a fibrous cord. It first loses its red colour, from the disappearance of the red corpuscles, becomes firmer and more adherent to the walls of the vessel, and finally appears like a cord of connective tissue indistinguishable from the walls of the vessel which have undergone a similar change.

The minute changes occurring during this process are not thoroughly understood. It is certain, however, that at one period of its transformation the clot is abundantly permeated by blood-vessels, which communicate both with the interior of the vessel and with the vasa vasorum in its walls; the manner, however, in which these vessels are formed is but imperfectly known. These vessels, after playing an important part in the organization of the clot, almost or entirely disappear, and the organized clot degenerates, as already stated, into fibrous tissue.

II. The clot may soften into a puriform fluid, disintegrate, and be in some cases carried away by the blood stream, leaving the vein natural or but little affected. Portions of the clot thus carried away by the blood may become impacted in the small blood-vessels of distant organs (embolism), giving rise to metastatic abscesses, pyæmia (?), or other grave complications. In other cases the disintegrated clot, instead of being removed by the blood, may become, as it were, encysted, by the formation of fresh coagula above and below.

XIII. 150.—The interior of the clot in this specimen is softened and diffuent, forming a puriform mass, separated from the circulation by a thin shell of fibrine shown in the preparation.

XIII. 108.—Two coagula of blood. The lower coagulum is enclosed in three distinct cysts, of which the outer two are membranous, and the inner consists chiefly of bone.

III. The clot may shrink to one side or be tunnelled through its centre by the blood.

XIII. 131.—Part of a superior mesenteric vein, the canal of which is occupied by a decolorized clot. By the side of this a narrow channel existed, and allowed of the passage of fluid blood. In the centre of the coagulum is a small cavity, its walls stained of a pink colour. It contained some clear serum.

IV. Calcareous changes in the clot sometimes occur, leading to the formation of phlebolithes or vein stones. These are generally of concentric structure, and consist of albuminous material impregnated with the salts of the blood, especially the phosphates and carbonate of lime. In some instances slender branching pieces of bone have been found in the veins; these are likewise in all probability examples of further organization of old clots.

XXXVIII. 3.—A collection of phlebolithes, or calculi from veins. Most of them are spherical; some are oval; they vary from half a line to half an inch in diameter; and some are laminated. They consist chiefly of phosphate of lime.

XIII. 161.—A portion of an external saphenous vein containing calcareous masses, which fill here and there the entire canal of the vessel, the wall being contracted around them.

XIII. 93.—A long and slender branching piece of bone, from the liver of a sheep. It was probably formed in obliterated branches of the portal vein.

Changes in the vein-walls, and in the tissues around.

I. There may be no apparent alteration in the vein-walls, or only some slight thickening of the internal and middle coats. This thickening, however, as pointed out by Mr. Callender, is in many cases due not to inflammation, but simply to the contraction and condensation of the vein-wall produced by the shrinking of the clot. This is well illustrated in the following specimen.

XIII. 157.—Part of an external saphenous vein. In consequence of a cancer-growth involving, and extending from, the lower part of the femur, the principal veins of the leg became obstructed by clots. The veins shrank upon the clots as the latter contracted, so that their canals in the midst of oedematous tissues were much reduced in size, and their walls appeared thickened as from inflammation. By injecting water they were easily restored to their natural size and appearance, as shown in the preparation.

XIII. 128.—The internal coat of the obstructed vein in this specimen is natural in appearance; the tissues around were much thickened and indurated.

XIII. 135.—A femoral vein filled by a clot; its walls present a natural appearance, but the tissues around were extensively ecchymosed.

II. When organization of the clot occurs the vein-walls and the parts around become infiltrated with inflammatory material, and

blending with the clot form with it at length, as already stated, a fibrous cord. The changes, however, which take place in the vein-walls, like those which occur in the organization of the clot, are very imperfectly understood. According to Cornil and Ranvier granulations grow out from the walls, and penetrating the clot unite with one another towards the centre. If this be a fact it explains the vascularization of the clot already referred to, as the granulations are said to contain blood-vessels which communicate with the vasa vasorum.

Obstruction to the circulation.

When a vein of considerable size is plugged the parts from which it conveys the blood become swelled, cedematous, and occasionally permanently indurated. The cedema of the lower extremity so common after parturition (phlegmasia alba dolens, as it is termed), is an example of this condition.

XIII. 128.—The left common iliac, the external iliac, part of the femoral and of the adjacent veins, irregularly distended and obliterated by clots, from a woman, who had suffered from much obscure pain about the pelvis and groins after a protracted labour. The lower extremities were cedematous.

XIII. 157.—The patient from whom this specimen was taken had marked cedema of the lower extremities.

SUPPURATIVE PHLEBITIS.

The condition of the veins known as suppurative phlebitis, like adhesive phlebitis, was formerly supposed to begin as an inflammation of the lining membrane of the vein; at the present time, however, it is regarded either as secondary to inflammation of tissues outside the vein, or to suppuration of a clot already formed within the vein. The first of these opinions is held by Mr. Callender, who describes the disease as "an infiltration of the tissues around each vein with serum and corpuscular lymph." "This quickly degenerates," he says, "and forms a series of abscesses or rather a diffused collection of pus. The veins at first contract, entangling some few coagula, but presently such portions dilate; beyond these other parts of the same vessel are undergoing, as the surrounding disease advances, the earlier process of contraction; and, again, beyond such portions, clots close their canal and mark the momentary limit of the disease. And so it extends, following the vein course. All branch vessels are closed with clots or involved otherwise in the disease, so that no blood flows through the vessel, and thus, and from the condition of the parts around, no nourishment can now reach the inner vein coat; so it dies, becoming cloudy, forming an

organic friable pulp, which gradually melts down until no trace of it remains. The inner coat being destroyed, pus finds its way into the dilated vessels either direct from the outer vein coats, or through them from the parts around; for these coats deprived like the inner of their blood supply frequently perish in the course of the disease."

According to others, Drs. Wilks and Moxon for instance, a clot is first formed in the veins, say as the result of an injury, and gradually extends up from twig to branch, and from branch to trunk; "this clot, poisoned with the diseased juices of the wound and purulent with in-wandered white blood-cells, inflames the wall as it spreads."

The exciting causes of suppurative phlebitis, may be enumerated as wounds, lacerations, or bruises of veins occurring in debilitated subjects. Thus, it is frequently met with in compound fracture, in ill-conditioned stumps, in cases of acute necrosis and caries in bone, in cases of malignant carbuncle, and in the umbilical vein after its division in unhealthy infants. Ligature of the veins was, moreover, formerly thought to be a common exciting cause. This belief, however, is now generally abandoned, for, in amputations, the *venae comites* are constantly tied, along with the arteries which they accompany, with no ill results; and in those cases where suppurative phlebitis has occurred after the application of a ligature to a vein, there have always been other conditions present, sufficient in themselves to account for it.

XIII. 19.—A femoral artery and vein from a stump. The coats of the vein are generally thickened and indurated. Inflammatory material is deposited upon the whole of the inner surface of the vein, as high up as the junction of the deep femoral vein; and the inflammatory material, mingled with clots of blood, completely fills the cavity of the vein to some distance above the amputated extremity.

The patient was a man, forty-five years old. The amputation was performed for compound fracture. The cavity remaining within the inflammatory material in the veins was full of pus.

XIII. 34.—A femoral vein, exhibiting an abundant and nearly uniform deposit of inflammatory material upon its inner surface. That part of the inner membrane of the vein which is exposed is of a dark red colour. The branches of the vein are filled by firm coagula.

These veins were taken from the left lower extremity of a man who had compound fracture of the right thigh. He died a month after the injury with obscure signs of phlebitis. The remaining cavities of the veins were full of pus; but no other veins were diseased.

XIII. 105.—Right external iliac and femoral vein. The coats of the vein are much thickened, and are consolidated with the surrounding tissues. Its interior is rough with inflammatory material deposited on its lining membrane. The lower and upper parts of the vein, and all

the branches proceeding from it, are filled by firm coagula composed of concentric layers of fibrine. The middle portion of the vein contained only soft fibrine and a fluid resembling pus.

From a young man, who died after amputation of the right arm, which was performed in consequence of traumatic gangrene.

XIII. 95.—Femoral vein from a stump, amputation of the leg having been performed about three weeks before death. The vein is dilated, thickened, and indurated, and there is a deposit of lymph upon its inner surface. Only one pair of valves remain in the whole extent of the vein from Poupart's ligament downwards; the others, it is presumed, disappeared in the course of previous disease of the vein. The superficial veins in the leg were extensively varicose.

In the amputation, on account of the hæmorrhage from the vein, its extremity was tied.

VARIX OR VARICOSE VEINS.

The veins most liable to become varicose are those of the lower extremities, the hæmorrhoidal, and the spermatic. Varix of the hæmorrhoidal and spermatic veins will be found treated of under diseases of the rectum and testicle respectively; our remarks will here be confined to the form of varix, commonly known as varicose veins, so frequent in the lower extremities.

A varicose vein is lengthened, dilated, and frequently tortuous, the dilatation being especially marked where the intermuscular veins open into the superficial. The valves, from the dilatation of the veins, cease to be of service, and become atrophied and sometimes reduced to mere fibrous cords stretching across the lumen of the vein. The walls are generally thickened from hypertrophy of the muscular coat, sometimes, however, they are attenuated and may even give way, producing severe hæmorrhage. The parts around become at first atrophied from the pressure of the dilated vein, but after a short time, œdematous, indurated, and thickened. The skin becomes congested, and especially liable to eczematous inflammation.

Ulceration of the congested tissues about the dilated veins (the varicose ulcer) is of frequent occurrence, and clots, as already described under adhesive phlebitis, often form in the affected veins.

Both the superficial and deep veins are generally involved in the varicose condition, indeed, some authors say always, maintaining that the disease begins in the dilatation of the deep veins. In this opinion the author cannot agree, as sometimes the varix is undoubtedly confined to the superficial veins.

Of the superficial veins, the disease may affect one of the main trunks as the internal saphenous, or the small subcutaneous venous radicals.

XIII. 77.—Portion of a vena saphena and its branches in a varicose state. The veins are generally and uniformly dilated; their coats are thickened and rigid, so that their canal remains open; and they have a convoluted and very tortuous course.

XIII. 79.—Portion of a vena saphena, the walls of which are in several places dilated in the form of pouches. Its coats are thickened, and there are thin cords, apparently the remains of its valves, extending across its cavity.

XIII. 78.—Portion of a femoral vein, exhibiting a partial dilatation of its coats in the form of a circumscribed pouch, projecting from one side. The pouch is lined by a continuation of the internal coat of the vein. Immediately above the pouch there are two valves in the vein, which have undergone no change. The coats of the vein are generally thickened.

CHAPTER XI.

INJURIES AND DISEASES OF THE RESPIRATORY TRACT.

DISEASES OF THE NOSE.

CHRONIC INFLAMMATION OF THE MUCOUS MEMBRANE.

CHRONIC inflammation of the mucous membrane covering the turbinated bones occasionally occurs. The inflamed mucous membrane appears thick, soft, pulpy, and of a dull red colour, and somewhat resembles a vascular tumour or polypus projecting into the nasal cavity, from which it may, however, be readily distinguished by its colour.

XXIII. 23.—Section of a nose, in which the mucous membrane covering the posterior portion of the inferior turbinated bone is inflamed and thickened.

POLYPI.

The term polypus has been applied genetically to several varieties of tumour in the nasal fossæ. Thus, mucous, fibrous, and malignant polypi have been described, but it would be better to restrict the use of the term to the first named variety.

Gelatinous or mucous polypi.

These occur as soft, gelatinous, semi-transparent growths springing from the mucous membrane covering the turbinated bones or the roof of the nasal cavity. They are generally multiple. They begin as flattened elevations of the mucous membrane, but soon become pedunculated. Though very vascular they are not attended with hæmorrhage as is the case with the fibrous variety. In structure they vary slightly, but more or less resemble the myxomata, and sometimes contain adenoid elements. They are covered with ciliated epithelium.

XXIII. 7.—Numerous polypi removed from the nose. They are of soft texture, semi-transparent, or gelatinous in aspect, and several of them were attached to the mucous membrane of the nose by long narrow pedicles.

XXIII. 9 and 10.—Similar specimens.

XXIII. 15.—Sections of a nose, exhibiting on each side large soft polypi, which are suspended from the mucous membrane covering the inferior and middle spongy bones. One polypus of smaller size is situated in the frontal sinus. They were probably of gelatinous aspect, though now, having collapsed and fluid having escaped from them, they appear opaque.

XXIII. 24.—A large lobed polypus of soft texture, which was extracted from the nose. A portion of it, which hung into the fauces, is opaque, apparently from the thickening of its investing membrane; the rest is soft and more nearly transparent.

It was removed from a young lady in whom obscure signs of its existence had been long observed. It was attached to the mucous membrane of the nose by the narrow portion by which it is now suspended. The larger part of it lay in, and projected from, the posterior aperture of the nostrils, through which the whole mass was extracted by seizing the portion which was hanging in the fauces.

Fibrous polypi.

Fibrous polypi usually spring from the periosteum covering the roof of the nose or lining the walls of the antrum. They are composed of fibrous tissue like the ordinary fibromata, sometimes with a few sarcomatous elements interspersed through their fibrous structure. They are pedunculated, and are apt to give rise to severe hæmorrhage; they may occasion much disfigurement by displacing surrounding parts.

There is no specimen of a fibrous polypus in the Museum.

Malignant polypi.

These commonly spring from the antrum, or some other of the sinuses connected with the nose. They are exceedingly rapid in their growth, and quickly infiltrate surrounding parts, causing great displacement and disfigurement. They protrude upwards into the orbit, forwards through the cheek, downwards into the mouth, and backwards into the fauces. They have an epitheliomatous, medullary, or sarcomatous structure. They frequently give rise to excessive hæmorrhage.

XXIII. 8.—Part of the right side of a face, in which the antrum and other nasal cavities and passages are completely filled by a soft medullary tumour, which also projects with an extensive sloughing

surface through the skin of the cheek, and through the anterior part of the gum and of the hard palate.

XXIII. 13.—The left side of a face, with a soft medullary tumour filling the antrum, and thence extending into the nostrils, and into the cavities of the mouth and orbit. The parts of the tumour which are exposed are broken and flocculent, as if sloughing.

GLANDERS.

XXIII. 21.—Portion of the septum nasi of a horse, exhibiting pustules and ulcers of the pituitary membrane. Each separate ulcer is small and circular, but on the posterior part of each surface of the septum there is a large extent of ulceration of an irregular form, probably the result of the coalescence of many small ulcers with each other.

The disease was produced by inoculation with matter taken from an abscess in the arm of a man who was believed to have been infected with glanders. Previous to the inoculation the horse was healthy.

NECROSIS OF THE TURBINATED BONES.

I. 257.—Six portions of hard, closely cancellous bone removed from the cavities of a nose. They appear to be parts of diseased turbinated bones, which had suffered necrosis after being exceedingly enlarged, thickened, and indurated.

The patient was forty years old; he had had syphilitic disease of one testicle, and had been for twelve years liable to syphilitic pains in the limbs, when he received a severe injury of the nose in a fall. This disease of the bones followed the injury. It was very slow in its progress, and the portions of bone here shown were not more than half of what was removed. After their removal the patient remained well and without deformity of the nose.

SPECIMEN ILLUSTRATING THE RESULT OF THE RHINO-PLASTIC OPERATION.

XXIII. 26.—The face of a man on which a new nose was formed three months before death from a portion of the integuments of the forehead.

Some years before the operation the patient had cut his nose off in a fit of insanity. He died with fever shortly after the union of the transplanted part was completed.

DISEASES AND INJURIES OF THE LARYNX.

ACUTE LARYNGITIS.

The post-mortem appearances of acute laryngitis convey but a faint idea of the intense congestion which characterized the disease during life, as the excess of blood is squeezed out of the mucous

membrane after death by reason of the recoil of the elastic tissue which is very abundant in the submucous tissue.

In a recent specimen the mucous membrane appears slightly red and injected, swelled, cedematous, and covered with a semi-purulent discharge, in places superficially ulcerated and here and there dotted with small ecchymoses. The submucous tissue is infiltrated with serum and inflammatory exudation. In museum specimens, however, the redness of the mucous membrane is no longer seen.

XXV. 7.—The larynx with a part of the trachea of a man who died with acute laryngitis. The mucous membrane covering the epiglottis, and lining the whole interior of the larynx, is swollen by a copious effusion of serum and inflammatory products in its tissue. The ventricles of the larynx are nearly obliterated by the swelling of the membrane and the consequent approximation of their borders. A small quantity of inflammatory exudation is seen on a part of the mucous membrane over the right side of the epiglottis and thyroid cartilage.

The patient was about fifty years old, and was healthy till within thirty hours of his death, when signs of acute laryngitis ensued. When brought to the hospital suffocation was imminent. Tracheotomy was immediately commenced; but he died before the operation was completed.

See also XXV. 19.

CHRONIC LARYNGITIS.

Chronic Laryngitis is generally of syphilitic origin or a sequel of the acute affection. Specimens show the mucous membrane to be thickened and indurated and covered with a muco-purulent discharge, and the glottis narrowed and encroached upon by the thickened mucous membrane.

XXV. 12.—The larynx and trachea of a man on whom the operation of tracheotomy was performed twelve years before death. The orifice in the trachea is situated immediately below the cricoid cartilage. The rima glottidis is almost closed by the thickening and contraction of the mucous membrane lining the larynx. The chordæ vocales also are so much shortened that the arytenoid cartilages are within a quarter of an inch of the angle of the thyroid cartilage. The trachea is healthy.

The patient continued to the time of his death to breathe easily through a canula in the opening made in the operation.

FOLLICULAR LARYNGITIS.

Follicular laryngitis, or clergyman's sore throat, is a chronic inflammation of the larynx beginning in the mucous follicles. It is most frequently met with in persons accustomed to loud and prolonged speaking; hence it is common in clergymen and town

hawkers; it also occurs in photographers and others exposed to chemical fumes.

The contact of irritating fumes or of cold air in prolonged speaking, induces dryness of the throat, to relieve which an extra quantity of mucous is secreted by the follicles. This over-stimulation of the follicles leads to their congestion and enlargement, the congestion subsequently passing imperceptibly into a chronic inflammation.

The mucous membrane besides being infiltrated, swelled, and thickened, presents a characteristic granular appearance from the enlargement of the mucous follicles, especially in the neighbourhood of the aryteno-epiglottidean folds where the follicles are most abundant. The mucous membrane is also superficially ulcerated in places. During life the follicles are surrounded by a red halo, and are frequently distended by a small quantity of glairy mucus.

XXV. 21.—A doubtful specimen of follicular laryngitis.

TUBERCULAR LARYNGITIS.

The favourite seat of tubercle in the larynx is the mucous membrane forming the aryteno-epiglottidean folds, and covering the lower and back part of the epiglottis and the arytenoid cartilages.

A small oval ulcer on the mucous membrane covering the arytenoid cartilages, immediately behind or over the posterior attachment of the true vocal cords, is very characteristic of tubercular ulceration.

Miliary tubercles are formed in the submucous tissue, giving a characteristic granular appearance to the overlying mucous membrane. The tubercles undergo the ordinary caseous change, and softening down lead to the formation of ulcers. The ulcers are at first distinct, small, round, with hard everted edges, and surrounded with characteristic induration of the mucous membrane, in part inflammatory, and in part due to more recent formation of tubercle. This later deposit of tubercle also softens down into ulcers which become confluent with those already formed, thus producing much irregular destruction of the mucous membrane. The ulceration may extend to the vocal cords or to the epiglottis; the natural contour of the latter structure is, however, rarely destroyed as it is in syphilis.

XXV. 3.—A larynx and trachea. The whole of the mucous membrane covering the inferior surface of the epiglottis and lining the larynx and trachea presents closely set, minute, and, for the most part, shallow ulcers, which have in some characters coalesced so as to give the appearance of diffuse superficial ulceration. Near the anterior extremity of each chorda vocalis there is a small, oval, excavated ulcer, the result, probably, of tuberculous disease.

XXV. 23.—A larynx, with part of the trachea, from a man in whom tracheotomy was performed two days before death. Upon the epiglottis, the arytenoid cartilages, and the chordæ vocales, the mucous membrane is thickened, ulcerated, and granular. Within the trachea, and especially upon its posterior wall, there is an almost continuous ulceration, which in some parts is superficial, in others extends deeply, and which at one point has formed an irregular opening through the walls of the trachea.

The patient died with phthisis. Tracheotomy was rendered necessary by imminent danger of suffocation; and the signs of the disease of the arynx had nearly concealed those of the disease of the lungs.

XXV. 27.—A larynx and trachea with the base of the tongue and the adjacent parts. The upper two-thirds of the epiglottis have been destroyed by tuberculous ulceration, and all the adjacent parts of the mucous membrane, as far down as the chordæ vocales, is deeply ulcerated. There is also a distinct oval ulcer on the mucous membrane covering each chorda vocalis, near its attachment to the arytenoid cartilage. The ulceration is irregular on each side, but exactly symmetrical.

ŒDEMA OF THE GLOTTIS.

Œdema of the glottis is a serous transudation into the loose submucous tissue covering the epiglottis, the aryteno-epiglottidean folds, and the adjacent portions of the cartilages of the larynx. It never extends below the true vocal cords, as the mucous membrane is tightly attached to those structures without the intervention of submucous tissue.

It generally occurs suddenly, supervening upon some previous inflammatory condition of the larynx or neighbouring parts, and is probably caused by the increased lateral pressure in the capillaries due to the compression of the blood-vessels at the focus of inflammation. It is a frequent termination of acute and chronic laryngitis, and is of common occurrence after scalds of the larynx. It sometimes appears to partake of an acute erysipelatous nature, and is then generally accompanied by acute cellular inflammation of the neck.

Œdema of the glottis of a passive character also occurs in dropsical affections in conjunction with œdema of other organs. Hence, it is a frequent termination of chronic Bright's disease. The anatomical appearances are well seen in the following specimens.

XXV. 7.—Œdema of the glottis, the result of acute laryngitis. The mucous membrane covering the epiglottis and lining the whole interior of the larynx is swollen by a copious effusion of serum into its submucous tissue. The ventricles of the larynx are nearly obliterated by the swelling of the membrane and the consequent approximation of their borders.

XXV. 31.—A larynx, with neighbouring parts. The mucous membrane lining the epiglottis and upper part of the larynx, the tonsils, and uvula is swollen and œdematous, so that the entrance to the pharynx is almost obliterated, and that of the larynx reduced to a narrow chink.

XXV. 29.—A larynx, of which all the mucous membrane is upraised and the glottis much narrowed by œdema. The epiglottis is thickened, and its edges turned backwards and downwards. The œdema extended also down to the pharynx and œsophagus, and was attended in the recent state with the characters of active inflammation.

These changes appear as the consequences of the lodgment of a fish-bone across the fauces, immediately in front of the epiglottis.

XXV. 14.—Edema of the glottis, following ulceration of the tongue, soft palate, and epiglottis.

XXV. 21.—Edema of the glottis, following ulceration of the larynx.

CROUP OR CROUPOUS INFLAMMATION.

Croupous inflammation is characterized by the formation of a false membrane in the larynx and trachea. The membrane, which is sometimes tough and fibrous, at other times soft and crumbling, is produced by the coagulation of albuminous and fibrinogenous material exuded upon the surface of the mucous membrane. It is composed of a delicate net work of fibres enclosing white blood corpuscles in its meshes. On removing the false membrane the mucous membrane of the larynx is found abraded and hypervascular, and the submucous tissue infiltrated with serum. The disease is generally confined to the larynx and trachea, but it may in severe cases spread into the bronchi.

Croup is essentially a disease of childhood, and it will be noted that whereas a large amount of submucous tissue exists in children, but little is found in adults.

XXV. 6.—The larynx and trachea of a child who died with croup. A false membrane, of a greenish colour, extends from the under surface of the epiglottis to about half an inch below the cricoid cartilage.

XXV. 11.—A similar specimen, except that the false membrane has extended into the main bronchial tubes.

XXV. 15.—In this specimen, which is similar to the above, tracheotomy has been performed.

XXV. 30.—A similar specimen to XXV. 11.

DIPHTHERITIC INFLAMMATION.

Many authorities maintain that no difference exists between the croupous and diphtheritic inflammations. It is generally taught, however, that whereas in croup the exuded material forming the

false membrane exists only on the surface of the mucous lining, in diphtheria it is found also in the substance of the mucous and sub-mucous tissue, where, from its interference with the circulation, it occasionally gives rise to gangrene and sloughing of the affected part. Diphtheria usually begins at the back of the fauces, and thence spreads to the larynx and nares. By some authorities it is thought to be due to a vegetable fungus. With this short account, which only serves to illustrate the local appearances of the larynx, the subject of diphtheria will be dismissed, as it more often comes under the observation of the physician than of the surgeon.

XXV. 40.—The larynx and trachea of a child who died with diphtheria. A membrane is seen covering a considerable portion of the mucous surface of the larynx.

XXV. 19.—A larynx and trachea, of which the mucous membrane is almost uniformly lined by a thin layer of inflammatory material, which is slightly adherent, and is rough and granulated on its inner surface.

The patient, a woman twenty-five years old, had had fever. During her recovery, but while she was very weak, symptoms of acute laryngitis ensued, for which laryngotomy was performed on the third day. She lived twelve hours; and after death all the bronchial tubes were found similarly lined by inflammatory material.

See also XXIV. 23.

TYPHOID ULCERATION OF THE LARYNX.

Ulceration of the larynx sometimes occurs during an attack of typhoid fever. The mucous membrane chiefly affected is that covering the arytenoid-cartilages, immediately posterior to the attachment of the vocal cords. The ulceration is generally limited in extent, but sometimes penetrates deeply and causes perichondritis which may terminate in necrosis of portions of the cartilages. At times, also, the ulceration destroys the whole of the free edge of the epiglottis.

XXV. 48.—The larynx and part of the trachea from a young woman who died after an attack of typhoid fever. On either side of the glottis, immediately posterior to the vocal cords, are seen the cavities of two small abscesses which surround the arytenoid cartilages. The cavity of the right one has been laid open to show the necrosed and bare arytenoid cartilage in its centre. The abscess on the left side is smaller.

VARIOLOUS ULCERATION OF THE LARYNX.

The larynx, in common with the mouth and throat, frequently participates in the eruption of smallpox, and on the bursting of the pustules presents a number of small round superficial ulcers scattered

over its mucous membrane. The eruption and resulting ulceration are frequently accompanied by the formation of a false membrane lining the larynx and trachea. In some cases the false membrane is present without any accompanying ulceration.

XXV. 10.—A larynx and trachea. Just above the chordæ vocales there is a fistulous ulcer beneath the mucous membrane of the back of the larynx, in front of the arytenoid cartilages. Part of its course is marked by a bristle. The mucous membrane covering the whole of the larynx and trachea is thickened, and rough on its internal surface. Near the attachment of the epiglottis are several small superficial ulcers.

The patient died with small-pox.

XXV. 13.—The larynx and trachea of a patient who died with small-pox. Inflammatory material in the form of a false membrane is thinly deposited over the surface of the mucous membrane.

SYPHILITIC DISEASE OF THE LARYNX.

In the early stages of syphilis, inflammation, indistinguishable in anatomical characters from other laryngeal inflammations, occurs in the larynx; later, condylomata and mucous tubercles make their appearance, especially on the vocal cords. In the so-called secondary stages ulcers occur upon the epiglottis, true and false vocal cords, and other parts of the larynx, but are with difficulty distinguished from other forms of ulcers. In the later stages the characteristic so-called tertiary ulcers, due to the breaking down of gummata, are common, and may be recognised by their irregular shape, sharp-cut excavated edges, and smooth base covered with yellow purulent discharge, by the surrounding induration, and by the deeply retracted cicatrices they leave on healing. The epiglottis is the part perhaps most frequently affected, and is often completely eaten away. As the ulcers increase in depth the perichondrium becomes involved, and necrosis of the cartilage may result, ossification of the cartilage sometimes preceding the necrosis. In other instances necrosis of the cartilage is the result of gummatous formations under the perichondrium.

The trachea is not uncommonly affected in a similar way.

XXV. 5.—A larynx, with the adjacent parts. The whole of the epiglottis and part of the arytenoid cartilages, with their connecting folds of membrane, have been removed by ulceration.

From a young woman who had long suffered from syphilis.

XXV. 24.—A tongue, with part of a larynx in which a circumscribed irregular ulceration has destroyed the epiglottis, the right arytenoid cartilage, and the fold of mucous membrane connecting them.

XXV. 8.—A larynx exhibiting a large well-defined ulceration of the mucous membrane extending into the substance of the cricoid cartilage,

which is partially ossified. Around the ulcer the mucous membrane is thickened and puckered.

From a woman twenty-four years old, who had had signs of laryngitis for a week, and died suffocated by the closure of the glottis.

XXV. 36.—The tongue and larynx of a man, who for some years before his death suffered severely from syphilis. He died suddenly, apparently suffocated. The mucous membrane covering the larynx, epiglottis, base of the tongue, and surrounding parts is much thickened and indurated. The papillæ circumvallatæ are considerably enlarged.

XXV. 9.—A larynx, exhibiting necrosis and separation of the left arytenoid cartilage, and of part of the cricoid cartilage. Previous to the necrosis the separated portions of cartilage had become osseous. The opening in the front of the trachea was made during life, for the relief of respiration.

The patient, a man between forty and fifty years old, had been profusely salivated for syphilitic disease.

XXV. 39.—The larynx of a man, aged fifty, who had had syphilis. It is laid open from behind, and the mucous membrane is seen to be thickened and indurated throughout. In different portions there is evidence of former ulceration. No traces of the epiglottis are visible. It appears to have been wholly destroyed, a slight ridge only marking its place of attachment.

XXV. 16.—A larynx in which a gumma had probably formed around the greater part of the thyroid cartilage. A large portion of the right ala of the cartilage is destroyed, and nearly all the rest of both its surfaces is exposed.

XXV. 46.—A larynx, from a man, aged forty-two, who died three days after tracheotomy had been performed for urgent symptoms of obstruction in the larynx. After death the glottis was found completely closed by œdema of the cellular tissue above the right aryteno-epiglottidean fold, which formed a soft, well-defined tumour, about the size and shape of a cob-nut. Ulceration, probably syphilitic, had invaded the right ventricle of the larynx, which was filled with a shining, semi-solid, and yellowish mass.

The patient had suffered from laryngeal symptoms for about three months before his admission into the hospital. There was a history of primary syphilis seven years previously, and at the time of his admission he had what was thought to be syphilitic gummatous disease of the tongue.

NEW GROWTHS OR POLYPI.

The new growths found in the larynx may be enumerated as the papillomatous or warty, the fibrous, the adenomatous, the sarcomatous, and the carcinomatous.

Papillomatous or warty growths.

The papillomata are the most common of the morbid growths

found in the larynx. They are especially frequent in early life. They spring from the mucous membrane, and have the same structure as papillomata in other situations. They assume the form either of warty, pedunculated excrescences, or of soft, flocculent, villous-like bodies. They more often spring from the front than from the back of the larynx, and occasionally grow from the vocal cords. They are frequently multiple, but after existing some time generally coalesce into one mass, which may attain such a size as ultimately to lead to a fatal attack of dyspnoea.

XXV. 17.—The larynx of a child two years old. The surface of the mucous membrane lining the thyroid cartilage, the ventricles of the larynx, and the lower part of the epiglottis, is occupied by a wart-like growth composed of numerous small, oval, pedunculated bodies, closely set together, and of a firm consistence.

The child had had dyspnoea from the time of birth, and died suffocated.

XXV. 25.—The larynx of a child three years old. The cavity of the larynx is almost entirely occupied by a warty growth, projecting from its mucous membrane.

The child had had dyspnoea and cough from a week after its birth.

XXV. 44.—A larynx, laid open and presenting large growths attached to the vocal cords. The growth on the left side is warty in character. The growths appear to have almost completely obstructed the entrance to the glottis.

From a man, aged fifty-six, who for some months had suffered with extreme hoarseness, and then considerable difficulty of breathing, with occasional paroxysms of severe dyspnoea. But he continued his occupation until a fatal paroxysm occurred. He was brought to the hospital dead.

XXV. 45.—The larynx and adjacent parts from a boy, aged nine years, who had suffered from symptoms of obstruction in the larynx for about six months before death, and had had occasional violent attacks of dyspnoea, in one of which he died suddenly. There is a well-marked papillomatous tumour on the vocal cords. The microscopic characters of the growth are those of well-marked papilloma, and differed remarkably from those of the ordinary epithelioma.

XXV. 38.—A larynx and part of a trachea. Irregular, soft growths are abundantly clustered about the vocal cords and ventricles. They project into the canal of the larynx, so as almost to close it.

From a boy, aged twelve, who, twelve months before his death, caught cold and suffered for a time with loss of voice. Treatment failed to benefit him, the aphonia persisting and being, before long, associated with dyspnoea. Respiration was attended with a stridulous sound. He followed his occupation without hindrance. He died suddenly from apnoea.

A section of the tumour is preserved in the Microscopical Cabinet (A. 80).

Fibromata or fibrous growths.

Fibrous polypi are much less common than the preceding variety. They occur as small, solitary, smooth, spherical, pedunculated or sessile growths, with a fibrous structure; and generally spring from the true vocal cords. The following specimen appears to be an example.

XXV. 42.—A larynx. On the upper and inner aspect of the right true vocal cord there is a small, conical, highly vascular, fibrous tumour.

From a man, aged sixty-three. There was no history of any laryngeal symptoms.

Adenomatous growths.

Adenomatous growths in the larynx consist, like the adenomata in other situations, of an hypertrophy of the glandular elements of the mucous membrane. Hence they generally occur in those parts of the larynx where the gland-tissue is most abundant, i.e. about the aryteno-epiglottidean folds and the ventricles. They are very rare. There are no specimens in the Museum.

Epithelioma.

Epithelioma of the larynx is generally secondary to epithelioma of the pharynx or other adjacent parts. When it occurs primarily in the larynx it springs from the mucous membrane covering the arytenoid cartilages, or from that forming the aryteno-epiglottidean folds. It commonly terminates in ulceration.

XXV. 35.—The larynx, pharynx, and base of the tongue shown from behind. The base of the tongue, the tonsils, and portions of the larynx are involved in an epithelial growth.

XXV. 33.—A larynx, laid open from behind, showing an epithelial growth which is attached to the right aryteno-epiglottidean fold.

A section of the growth is preserved in the Microscopical Cabinet (A. 31).

Medullary cancer.

Medullary cancer but rarely occurs in the larynx. It soon involves the whole of the larynx and adjacent parts, and is rapidly fatal. The appearances of the growth are seen in the following specimen.

XXV. 22.—A larynx, with some of the contiguous lymphatic glands. There is a flat spongy growth, apparently of medullary cancer, on the mucous membrane covering the epiglottis and the superior orifice of the larynx. A part of this growth has ulcerated. A deposit of soft substance nearly fills the enlarged lymphatic glands.

Scirrhus cancer.

Scirrhus cancer of the larynx is very rare. The following is a well-marked specimen.

XXV. 47.—Hard carcinoma of the pharynx and larynx, encroaching upon the left vocal cord. The patient was a man, aged sixty-three. Tracheotomy was performed. The symptoms had existed about six months.

OSSIFICATION OF THE CARTILAGES.

Ossification of the cartilages of the larynx and trachea is a senile change, and can hardly be regarded as a disease. It must, however, be carefully distinguished from the ossific changes which the cartilages sometimes undergo before suffering necrosis in syphilitic and other ulcerative affections of the larynx.

XXV. 18.—A larynx, from an old woman. The thyroid, cricoid, and arytenoid cartilages are almost entirely ossified. Osseous matter is also deposited in one of the thyro-hyoid ligaments and in the epiglottis.

Ossification of the epiglottis is exceedingly rare. It is said in the text-books never to occur.

XXV. 20.—Portion of a trachea, from an old man. The cartilages are all ossified.

WOUNDS.

XXV. 32.—A larynx and os hyoides, partially separated by a transverse incised wound which was the cause of death.

IMPACTION OF FOREIGN BODIES.

Foreign bodies are apt to become impacted in the ventricles, in the glottis, or between the aryteno-epiglottidean folds. If not soon removed they cause death by inducing spasm or cedema of the glottis.

XXV. 26.—The larynx of a child, three years old, which was suffocated by a pill lodging just beneath the vocal cords. Small portions of the pill lie loose at the bottom of the bottle, but the greater part of it has been dissolved by the alcohol.

XXV. 29.—A larynx, exhibiting the lodgment of a fish-bone across the fauces immediately in front of the epiglottis.

CHAPTER XII.

INJURIES AND DISEASES OF THE DIGESTIVE TRACT.

DISEASES OF THE LIPS AND CHEEKS.

EPITHELIOMA OF THE LIPS.

EPITHELIOMA nearly always occurs on the lower lip. It generally begins as a small crack or ulcer covered with a dry scab, or as a warty induration of the mucous membrane. If an ulcer or fissure it extends and deepens; if an induration it increases to an irregular warty mass, which subsequently ulcerates. The cancer finally involves the whole lip and adjacent parts, and affects the neighbouring lymphatic glands, but is not reproduced in distant organs, like other forms of cancer. It has generally been attributed to the heat and irritation caused by smoking clay pipes with short stems and unglazed mouthpieces.

Epithelioma is apt to be mistaken for hard chancre; the following facts should aid in the diagnosis:—Epithelioma occurs more often on the lower, chancre on the upper lip; epithelioma is more frequent in men, chancre in women; epithelioma affects the glands at a late period of the disease, chancre generally within six weeks after its appearance; chancre, moreover, is sooner or later accompanied by secondary symptoms, and yields to treatment, whereas epithelioma steadily increases in spite of treatment.

The only specimens of epithelioma of the lips in the Museum are two which were removed from the exceptional situation of the upper lip.

XXXV. 12.—An epithelioma of the upper lip, which was removed by operation.

XXXV. 22.—An epithelioma of the upper lip, removed from a man sixty years old.

Return of epithelioma, after removal from the lip, in the cheek, and subsequently in the lower jaw.

XXXV. 96.—Section of a mass of epithelial cancer embedded in the right cheek. It occupies the whole thickness of the cheek, upraising

equally the skin and the mucous membrane, and just projecting through them both at small ulcerated apertures. It appears as a circumscribed infiltration of the tissues, of irregular rounded shape, about two inches in diameter. Its section appears opaque-white, with some marks of blood stains; its substance is firm and close-textured, but friable, not creamy.

The patient was thirty-seven years old. A year before the removal of this disease a portion of his lower lip, with epithelial cancer, which had been four years in progress, was excised. Within three months of this second operation the disease reappeared beneath the scar and rapidly increased. It was removed together with a large portion of the lower jaw, to which the cancerous substance adhered. The wound did not completely heal; but the cancer, which again appeared in it, made comparatively slow though extensive progress. Death occurred nearly three years after the first operation. The lip on which the first operation was performed remained healthy to the last. The specimen is drawn in No. 313.

LABIAL GLANDULAR TUMOURS.

Tumours, called by Sir James Paget labial glandular, consisting of gland substance surrounded by more or less fibrous tissue, and sometimes intermixed with cartilaginous and myxomatous elements, and even occasionally with bone, are not of unfrequent occurrence in the lips. They are generally of slow growth, lobulated on the surface, and nearer the mucous membrane than the skin. They are more common in the upper than in the lower lip. Their general appearances are well seen in the following specimen, upon which Sir James Paget's original description was based.

XXXV. 87.—Section of a tumour removed from an upper lip. A portion of the mucous membrane of the lip is closely connected with a part of its surface. The tumour was of spheroidal shape, nearly an inch in diameter, embedded in the whole thickness of the lip. It is lobed, firm, and elastic, closely connected, but not confused with the adjacent tissues. Its cut surface is creamy-white and greyish, with ruddy spots.

The patient was a healthy looking middle-aged man. The tumour had been growing for twelve years, and was inconvenient only from its bulk. Its microscopic structures were those of a conglomerate secreting gland, with well-formed veins and tubes lined and partly filled with nucleated cells, wanting only the system of branching ducts. The case is described and parts of the microscopic structures are represented in Sir James Paget's 'Lectures on Tumours,' p. 262, pl. 36.

NÆVUS OF THE CHEEK.

XXXV. 21.—Portions of a nævus, which were removed from the inside of the cheek of a boy fourteen years old. In the upper portion a

section of the *nævus* is made, showing the consolidation which its structure had undergone from repeated attacks of inflammation. With the middle portion an inch and a quarter of the parotid duct are connected. A bristle is passed through the duct. On this portion a multitude of fine fringe-like processes have been formed by the enlargement of the papillæ of the mucous membrane of the cheek. No inconvenience followed the removal of the piece of the parotid duct.

CONGENITAL MALFORMATION OF THE LIPS.

HARELIP.

Harelip is a congenital malformation in which the upper lip is vertically cleft on one or both sides of the median line. It is the result of the non-union of the superior maxillary processes, which form the lateral portions of the lip, with the naso-frontal process which forms the mesial portion. Hence the fissure will be opposite the suture between the superior and intermaxillary bones, the situation in which the union between the above-mentioned processes normally occurs. The malformation will be single or double, according as the arrest of development occurs on one or both sides.

The fissure may be little more than a notch in the free margin of the lip, or it may extend completely through the whole substance of the lip into the nostril above. It is frequently accompanied by cleft of the hard palate, or of both the hard and soft palates, from the arrest of development affecting also the deeper parts. When the fissure is double the central portion of the lip, *i. e.* that developed from the naso-frontal process, is generally shorter than natural, and the intermaxillary bone frequently projects forwards, carrying the incisor teeth with it.

Series A. 9.—Head and limbs of a *fœtus*, with double harelip and a wide complete fissure of the palate. Each hand has five fingers and a thumb, and each foot seven toes.

Series A. 10a.—Single harelip on the left side combined with complete fissure of the hard and soft palates.

Series A. 230.—Harelip on the left side combined with a cleft of the hard and soft palates. The intermaxillary bone is fused with the right maxilla.

DISEASES OF THE GUMS.

Epulis is the only disease of the gums illustrated in the Museum.

EPULIS.

The term *epulis* has been variously used by authors; some have applied it indiscriminately to any tumour growing upon the gums;

others have restricted it to those having a fibrous structure; others, again, have applied it to those only of the many tumours of the gums that have a fibrous, myeloid, or an epitheliomatous structure. The last application of the term is, perhaps, more generally in use, and will be adopted here.

The fibrous epulis.

The fibrous epulis is little more than an hypertrophy of the gums, and is composed almost entirely of fibrous tissue in which a few spindle-shaped cells are occasionally found. It commonly begins on one of the little tongue-like processes of gum which project between the teeth, and is nearly always connected with the periosteum lining the tooth-socket. It appears as a flattened, firm, dense, often slightly lobulated tumour, covered with mucous membrane of the same colour as that of the rest of the gums. As it increases in size the tooth or teeth with which it is connected become loose and fall out; the bone below becomes hypervascular, and osseous spicula grow up from it into the deep part of the tumour. The fibrous epulis is usually of slow growth, but may attain a large size.

I. 247.—Sections of the front of a lower jaw which was removed with an epulis. The epulis is of a rounded oval form and a firm obscurely fibrous texture; it rose to the height of half an inch from the margin of the jaw and overlapped both its surfaces. One of the sections shows that the part of the jaw on which the tumour rested is in its own texture sound; its surface was smooth and the periosteum healthy.

From a young woman in whom the disease had made slow progress.

XXIII. 14.—A tumour removed from the alveolar margin of a superior maxillary bone. It is of a round form, and consists of a very firm fibrous tissue, with specks of bone in it.

XXXV. 39.—An epulis removed from the lower jaw of a girl. It is of an irregularly oval form, and composed of a firm, white, obscurely fibrous substance, like the tissue of healthy gum. The narrow base by which it was adherent to the jaw contains numerous osseous spicula. Its free surface is covered by healthy mucous membrane.

The myeloid epulis.

The myeloid epulis bears a general resemblance to the fibrous variety, but is softer, more vascular, and has large myeloid cells interspersed among the fibrous elements. Like the fibrous, the myeloid variety is frequently connected with the periodontal membrane.

There are no specimens in the Museum.

The epitheliomatous epulis.

The epitheliomatous epulis has a structure resembling that of epithelioma of other situations.

There are no specimens in the Museum.

DISEASES OF THE JAWS.

NECROSIS OF THE JAWS.

The lower jaw is more frequently the subject of necrosis than the upper, a fact depending partly upon its poorer blood supply and partly upon the tendency of necrosis to affect compact in preference to cancellous bone. The whole, or a part only, such as the alveolar margin of the upper and the anterior wall of the lower, may suffer. But for the same reasons that necrosis is more frequent it is also more extensive in the lower than in the upper jaw. The teeth become loosened and generally drop out; at times, however, they retain their connection with the gums and remain *in situ* long after the sequestrum is removed. In young subjects the germs of the permanent teeth usually perish along with the temporary set; yet in exceptional cases they have escaped destruction, and have been cut subsequently to the formation of new bone around them, a fact which has led some into the error of supposing that new dental germs had been formed.

Necrosis of the jaw is generally dependent upon periostitis induced by inhaling phosphorous fumes, by fever, syphilis, the abuse of mercury, or by cancrum oris, or other ulcerative affections of the mouth. The necrosis may also be the result of injury of the jaw.

Phosphorous necrosis.

Necrosis of the jaw was formerly common in operatives engaged in lucifer-match manufactories, and was induced by inhaling phosphorous fumes. Since the introduction of matches tipped with the amorphous form of phosphorus this disease has not been so frequent. A case is reported by Sir James Paget where necrosis was induced by inhaling phosphoric acid as a supposed remedy for nervousness. The disease is now generally thought to be the result of a local periostitis, and to occur only where the teeth are carious or have been lost, with exposure of the dental periosteum to the direct action of the fumes. Langenbeck, however, still supports the older theory that it is dependent on a constitutional condition

induced by the phosphorous fumes. No doubt constitutional symptoms are frequently observed, but they are rather the result than the cause of necrosis.

The peculiar pumice-like deposit of new bone, which nearly always covers the sequestrum in cases of phosphorous necrosis, and was formerly thought to be characteristic of it, has been occasionally found upon sequestra the result of causes other than phosphorus. It appears to consist of ill-formed bone, the Haversian canals of which are larger than normal and placed at right angles, instead of parallel to the surface of the old bone. Some observers consider that this pumice-like material is formed by the periosteum, whilst the new bone ordinarily formed in jaw-necrosis is produced by the soft parts. See I. 168.

I. 311.—Nearly the whole of the lower jaw in a state of necrosis, removed from a man who had been engaged for some time in a lucifer-match manufactory.

I. 315.—The whole lower jaw, excepting the right condyle, in a state of necrosis.

From a man, aged forty, who had been for some time at work in a lucifer-match manufactory.

I. 338.—The whole of the lower jaw, with the exception of the left condyle, in a state of necrosis from a man, aged forty, who had worked in a lucifer-match manufactory for nearly twenty years. The jaw had been affected for nearly two years. The jaw was in great part reproduced.

I. 372.—The whole lower jaw in a state of necrosis from a boy who had worked in a match manufactory.

I. 373.—The superior maxillary and portions of adjoining bones in a state of necrosis. The necrosis occurred in the patient after the removal of the lower jaw seen in I. 372.

I. 322.—The greater portion of two superior maxillary bones in a state of necrosis, removed from a man aged thirty-four. The disease and death of the bone were the result of exposure to the fumes of phosphoric acid twelve weeks previously.

Syphilitic necrosis.

The parts of the jaw most frequently involved in syphilitic necrosis are the alveolar borders, the palatine processes of the upper, and the compact tissue of the anterior wall of the lower jaw.

I. 185.—Section of a girl's face in which syphilitic necrosis and ulceration affected large portions of the maxillary and malar bones. The separate portions of bone were exfoliated.

Mercurial necrosis.

Since mercury has been more sparingly used, mercurial necrosis has been less common. There is but one specimen in the Museum, in which necrosis of the jaw is referred to the use of mercury, but as only a few grains were administered, and as the patient was suffering at the time from fever, it appears more likely to have been the result of the fever.

I. 102.—A lower jaw, nearly the whole body of which suffered necrosis after the administration of a few grains of calomel in a case of fever. The dead bone is in part separated, and a small quantity of new bone is deposited around it. The necrosis should probably be ascribed to the constitutional condition of the patient.

Necrosis from fever.

Although necrosis has occasionally been observed after other fevers, it is as the result of the exanthematous (especially scarlet fever) that it has generally occurred. Necrosis following fever generally affects only the alveolar border, never the whole of the jaw. It especially occurs in children about the age of five or six, when the jaw contains the whole of the first and most of the germs of the second set of teeth; hence it would appear that the teeth, as dermal appendages, frequently suffer in common with the skin, on which these fevers have a specific action.

The jaw is generally symmetrically affected—a distinguishing characteristic of this form of necrosis.

A specimen of necrosis of the jaw after rheumatic fever follows.

I. 168.—A lower jaw, which was separated after necrosis, from a girl who had suffered from rheumatic fever.

Necrosis from cancrum oris.

Cancrum oris, in common with other ulcerative affections of the mouth, is apt to lead to necrosis of the jaw. A good specimen follows.

I. 227.—A large portion of the upper jaw-bone of a child, which exfoliated after cancrum oris.

Necrosis from injury.

Necrosis of the jaw, as a result of injury, is somewhat common. Thus, small exfoliations, hardly worthy of a place in a Museum, are frequently met with after the extraction of a tooth, or after a blow or fall upon the face. A specimen of necrosis following a blow upon the jaw follows.

I. 145.—Portion of an upper jaw, with two molar teeth, which separated by exfoliation. The necrosis was consequent upon a severe blow upon the face.

REPRODUCTION OF THE JAW AFTER NECROSIS.

It was formerly believed, and is still stated in several text-books, that new bone is never formed after necrosis of the jaw. As far as the upper jaw is concerned this statement is substantially correct, for, it is only in a few cases, where the reproduction has been represented by a few scattered plates of bone, that any fresh osseous material has been observed. Except in the case of children, the subjects of exanthematous necrosis of the jaw, not even does fibrous tissue appear as a substitute for the old bone. The case however, is very different after necrosis of the lower jaw, where very substantial reproduction takes place, and where even an attempt at the reproduction of the condyle and coronoid process may occur. The teeth, as might be expected, are not reproduced (see p. 279).

I. 342.—A lower jaw, which was reproduced in nearly its entire state in the man from whom the necrosed jaw (I. 138) was taken. The present specimen was removed after death. It consists for the most part of well-developed bone with intervals of fibrous tissue in various stages of ossification.

I. 374.—A similar specimen, with the exception that the reproduction is much more complete. The coronoid process is completely reproduced on the left side and partly on the right. There has also been an attempt of reproduction of the condyles.

TUMOURS OF THE JAWS.

FIBROUS TUMOURS.

Fibrous tumours are not an uncommon affection of the jaws; they occur in both upper and lower with equal frequency. In structure they resemble fibrous tumours of other parts, being generally white, dense, hard, and fibrous on section. They have been supposed to be recurrent, but their occasional return is probably due to their imperfect removal. They are liable to the same degeneration as fibrous tumours in other situations.

Fibrous tumours of the upper jaw spring either from the periosteum covering the alveoli, or from that lining the antrum. They are generally lobulated, growing in all directions, and insinuating themselves into the different fissures and fossæ in their neighbourhood. When beginning in the antrum they expand the walls of that cavity, encroaching upon the mouth, orbit, or nose, protruding

forwards on to the cheek or backwards into the spheno-maxillary fossa, or in several or all of these directions at the same time.

Fibrous tumours of the lower jaw arise either from the periosteum or from the interior of the jaw. In the former case they usually occur upon the front of the jaw, and have a more or less smooth surface and globular form; in some instances they almost surround the jaw. They differ from the fibrous tumours of the gums (epulides) merely in their situation and their larger size. In the latter case, *i. e.* when they spring from the interior of the jaw, they gradually expand the bone around them, and finally cause absorption of their bony case and protrude externally, the external wall of the jaw generally yielding more and giving way sooner than the internal.

M. Brocca states that there are fibrous tumours which occasionally originate from tooth germs, but excepting that they are encapsulated, and only occur in young subjects who have not completed their second dentition, they do not differ from the ordinary kind.

In the upper jaw.

I. 276.—An upper jaw-bone with a large oval tumour, which appears to have originated in its interior, and, in growing, to have disparted and extended its walls in every direction. The tumour, elongated from above downwards, projected remarkably into the orbit, lifting up the orbital plate of the jaw-bone. It has a very dense, compact texture and a greyish basis, which is intersected by curved and reticulated shining white lines, as in the well-marked fibrous tumours of the uterus.

I. 361.—Right superior maxilla, removed by operation, from a girl aged twenty-six. Seven years previously a small growth had been removed from the alveolar process of the same bone. The growth recurred four years afterwards. The whole of the interior of the bone is occupied by a firm fibrous growth.

In the lower jaw.

The periosteal variety.—XXXV. 92.—Part of the base of a lower jaw, and of a tumour which extended from its angle to the place of the canine tooth on the left side. The tumour appears to spring from both surfaces as well as from the alveolar border of the jaw; it is intimately connected with them, and their periosteum is involved in it. It rises, with a nearly smooth, oval surface, to a height of almost an inch from the jaw. Its texture is dense, tough, elastic, white, with glistening bands, like a section of fibrous cartilage. Its posterior and lower surface is covered with a thin plate of bone, which appears to have grown over it from the lower border of the jaw.

The patient was a woman, twenty-eight years old. The tumour had been two years in progress, and had seemed to spring from the socket

of a tooth which was extracted on account of caries. During the first eighteen months it was painful; in its later progress it was much less so. The patient remained well for at least a year after its removal.

The microscope revealed a well-developed fibrous tissue.

The endosteal variety.—I. 280.—A vertical section of the left half of a lower jaw-bone, the walls of which are disparted and extended round a large oval tumour growing within them. The tumour extends from the right side of the symphysis, along the entire length of the left horizontal portion of the jaw, and about one third of its ascending portion. It is composed of a very firm, dense, fibrous tissue.

The investment of bone, formed for it by the walls of the jaw, is complete, and might be separated from it. An appearance of softening in its centre is due to an artificial perforation previous to its removal.

The patient was a healthy-looking woman, thirty-two years old. The tumour, ascribed to a blow, had been observed between seven and eight years, and had gradually increased without pain. Recovery followed its removal.

I. 135.—Section of a tumour, with the portion of the lower jaw from which it originated. The portion of jaw comprises the whole of its left ramus, condyle, and body, to within a short distance of the symphysis. The morbid growth apparently originated in the cancellous texture of the jaw, a part of its outer surface being formed by the walls of the bone expanded over it. It consists of fibrous tissue, with specks of osseous matter dispersed through it.

The patient was a man about twenty-two years of age. He recovered quickly after the removal of these parts.

I. 136, 148.—Similar specimens.

Fibrous tumours, although generally hard and firm, are occasionally soft and succulent, approaching the myxomata in consistency. The following is apparently a specimen of this variety.

I. 147.—Sections of a tumour, with the side of the body of the lower jaw in which it originated; removed by operation. Part of the mucous membrane of the mouth, unaltered in structure, is extended over the upper surface of the tumour. The disease originated in the cancellous texture of the jaw. The walls of the bone are expanded into a thin case enclosing the tumour, but, in consequence of the absorption of the bone in some situations, this case is incomplete. The morbid growth consists of soft fibrous tissue, with cysts dispersed through it, which cysts contained a glairy fluid. The boundaries of some of the cysts are thin plates of bone, apparently the remains of the original cancellous texture of the jaw.

The cysts were probably the result of *mucoid* degeneration of portions of the tumour.

A section of the tumour is preserved in the Microscopical Cabinet (A. 32).

CARTILAGINOUS TUMOURS.

Cartilaginous tumours of the jaws are rare. They begin either on the surface of the jaws or in the antrum, and extend in all directions, causing great destruction of surrounding parts. In structure they resemble ordinary cartilaginous tumours, and, like them, are liable to calcareous degeneration. They are liable to return when removed, and have been known to affect distant organs.

XXXV. 47.—Section of a large tumour, formed in the face of a lad sixteen years old. The greater part of it occupies the situation of the superior maxillary bones, which are completely absorbed. Above, the tumour has extended through the left side of the base of the skull into its cavity, where it forms a large projection in the situation of the anterior lobes of the cerebrum; below, it is united to the soft palate; in front, it protrudes, and distends the left nostril, and has caused the ulceration of a part of the integuments of the face. The outer surface of the tumour is nodulated; its interior, shown by the section, is formed of close-set nodules and masses of cartilage, partially and irregularly ossified, and in some parts intersected by layers of a softer, probably fibrous, tissue. A portion of its external surface, projecting below the left nostril, has sloughed.

OSSEOUS TUMOURS.

Osseous tumours differ somewhat according as they implicate the lower or the upper jaw.

In the lower jaw they generally appear as pedunculated outgrowths springing from the body or from the ramus of the jaw, in the neighbourhood of the angle, and are commonly hard and compact, like the ivory exostoses. Occasionally, however, they occur on other parts of the jaw, when they have usually a cancellous structure, and are tipped with cartilage. The latter are regarded by some as ossified enchondromata.

In the upper jaw two forms of osseous tumour occur. Of these, one kind resembles ordinary exostosis, being composed of cancellous or of hard ivory-like bone, and generally grows upon the surface of the jaw. The other variety has already been described under the osteomata as "diffused osseous growths" (p. 53). These latter begin in the walls of the antrum and grow inwards into that cavity until it is completely filled, while at the same time they frequently occur upon the outer surface of the maxillary and spread to the neighbouring bones. See I. 62 and 250.

In the lower jaw. I. 348.—A portion of the left side of the body of the lower jaw of a child, corresponding with the canine and the first two molar teeth; projecting from its external surface is a tumour composed of cancellous tissue covered with a layer of compact bone. The

periosteum investing the tumour is greatly thickened, but was found under the microscope to be normal in its structure.

From a child ten years old. A tumour of the jaw had been observed eighteen months, and a portion of it had been removed about four months before she came into the hospital. On her admission the growth was increasing so rapidly, and the parts over it so vascular, that it was feared it was of a malignant nature. The child recovered after the operation.

In the upper jaw. I. 354.—A dense osseous tumour, involving the whole of the left superior maxillary bone. From a boy aged nine years.

SARCOMATOUS TUMOURS.

All varieties of sarcoma occur in the jaws. The tumours of the jaws designated in the Museum Catalogue as fibro-plastic, fibro-nucleated, recurrent fibroid, and myeloid, will be found under this heading.

Spindle-celled sarcomata.

Spindle-celled sarcomata occur both in the upper and in the lower jaw, but are rather rare. They generally spring from the periosteum and invade the bone as they increase in size. To outward appearance they resemble fibrous tumours; microscopically they have the structure of spindle-celled sarcomata of other situations. They are liable to return after removal. They are called in the Catalogue recurrent fibroid tumours.

I. 149.—Sections of a tumour and of the portion of the lower jaw from which it originated, removed by operation. The portion of the jaw comprises its whole side, from the angle to within a short distance of the symphysis. The morbid growth consists of a grey, dense, fibrous substance, originating from the alveolar border and from the outer surface of the jaw. Part of the alveolar border of the jaw has been absorbed, and in this situation the morbid growth appears to extend into the bone. The contiguous substance of the jaw is of an ivory-like hardness, and its cancellous texture is consolidated. From a female aged thirty.

Microscopically the tumour resembles the spindle-celled sarcomata. A section of it is contained in the Microscopical Cabinet (A. 33).

I. 150.—Sections of a tumour which formed in the side of the neck immediately below the seat of the operation by which the parts last described were removed. The tumour consists throughout of a firm fibrous substance. The irregularity of surface and looser texture which it presents in one situation result from the ulceration and sloughing of its substance, which commenced a short time before death. With the smaller section of the tumour is connected a part of the lower jaw; its texture is sound, but the morbid growth is closely attached to its surface. Other portions of the same are shown in No. 251.

The tumour has the microscopic structure of the spindle-celled sarcomata. A section of the tumour is contained in the Microscopical Cabinet (A. 34).

I. 151.—Sections of a tumour, which occupied the situation of the superior maxillary bone and was removed by operation. The whole of the natural structure of the superior maxillary bone has disappeared. The mucous membrane which covered the palatine surface of the bone extends over a part of the tumour. The morbid growth consists of a moderately firm, fatty-looking substance, with minute cysts and spicula of bone dispersed through it.

From a man aged forty-six. The disease returned after the operation, and the patient died in consequence of hæmorrhage from ulceration of the internal carotid artery, which became involved in an extension of the disease. A section of the tumour is contained in the Microscopical Cabinet (A. 35).

Return of a spindle-celled sarcoma.

I. 251.—Part of a lower jaw, including one of its rami and symphysis, embedded in a large spindle-celled sarcoma, taken after death from the patient from whom the tumour shown in No. 150 was removed two years previously. The tumour projects with an ulcerated surface into the side and floor of the mouth, displacing the tongue and soft palate, and rising as high as the condyle of the jaw. It has one or two smaller tumours of the same kind resting on its surface, but not connected with the jaw.

Myeloid sarcomata.

The myeloid sarcomata may affect either the upper or lower jaw. They sometimes arise from the periosteum, but more commonly from the interior of the bone, which, as they increase in size, becomes expanded around them, and at last gives way, allowing them to protrude externally. They have all the characters of the myeloid sarcomata; they are smooth, translucent, and waxy-looking; in colour either of a yellowish-grey, suffused with blotches of brown, crimson, or purple, or of the uniform tint of voluntary muscle; they present under the microscope the characteristic myeloid cells. They are generally single and of slow growth, they rarely undergo ossification, but are liable to mucoid degeneration leading to the formation of cysts.

In the lower jaw. I. 23.—The front of the lower jaw of a child, which was removed by operation on account of a tumour arising in the cancellous texture of the bone, and thence protruding into the mouth. In the progress of the operation, the front of the jaw separated into an upper and a lower portion. With the upper portion there is a part of the tumour, which was lodged in a cavity of the bone formed by the absorption of its cancellous texture and by the separation of its anterior

and posterior walls. The tumour consisted throughout of a red and fleshy mass, resembling a piece of lacerated spleen. Microscopically it has the structure of a myeloid sarcoma. A section of the tumour is contained in the Microscopical Cabinet (A. 86).

I. 273.—Section of the anterior part of a lower jaw, and of a tumour formed within it. The anterior and posterior walls of the jaw are disparted, and form a thin layer, like a capsule of bone, around the tumour, which has grown between and gradually extended them. Their tissue appears unchanged. The tumour is of oval form, and its substance is generally firm and compact, without any distinct fibrous or other texture; immediately after removal it had a greyish tinge, suffused with deep crimson, brownish, and purple blotches; it presented the microscopic characters of a "myeloid" tumour. The cut surface of the tumour presents the sections of several cysts, which were irregularly placed within its substance and were filled with clear yellowish fluid.

The patient was a lad eighteen years old. The tumour had been observed gradually increasing, without pain, for eight months, and projected into the mouth through one of the alveoli. He remained well for more than four years after the operation.

In the upper jaw. I. 274.—Section of the fore part of an upper jaw, with a myeloid sarcoma. The tumour, seated within and above the alveolar part of the jaw, has separated and extended, in its growth, the anterior and the palatine walls of the bone, which form a kind of bony investment for it.

The patient was a girl, twenty years of age, of healthy appearance. The tumour had been observed, as a projection in the left nostril, ten weeks before it was removed.

I. 275.—Portion of an upper jaw, including nearly the whole of its front wall, extended over a large myeloid sarcoma, which presented all the characters of the two preceding, except in that its substance had almost uniformly the colour of robust voluntary muscle. Nearly the whole of this colour was quickly discharged, as if by bleaching, when the tumour was immersed in alcohol. It now presents a uniform pale colour and a firm compact substance, in which portions of cancellous bony tissue are irregularly scattered.

The patient was twenty-two years old. Growths, like common epulis, had been thrice removed from her right upper jaw before the growth of this tumour was observed. The last of the three growths extended through an alveolus into the cavity of the antrum, which it nearly filled. All, however, appeared to be removed, and the wound of the operation healed soundly. Nine weeks afterwards this tumour in the right upper jaw-bone was observed, projecting in all directions. It regularly increased, and about two months later a similar tumour appeared in the left upper jaw. Both tumours grew rather quickly. Six months after the appearance of the first the greater part of the jaw-bone was cut away (including the part here preserved), and the rest of the tumour, which appeared to fill the whole interior of the jaw-bone, was removed piecemeal. The wound healed soundly, and during

the nine months following the operation no reproduction of the growth had taken place; the tumour in the left upper jaw-bone had somewhat diminished and become harder, and two small swellings which had long existed on one of the parietal bones disappeared.

CANCER.

Cancerous growths of the jaws are nearly always of the medullary variety; a few specimens of scirrhus, however, are preserved in the Hunterian Museum. The jaws, moreover, may be invaded by epithelioma of the gums or neighbouring parts.

Medullary cancer occurs both in the upper and the lower jaw. In the upper jaw it generally begins in the mucous membrane lining the antrum, and, rapidly increasing in size, expands the walls of that cavity around it, causing much disfigurement from displacement of the surrounding parts. Thus, it may project through the roof of the antrum into the orbit, through the internal wall into the nasal cavity, through the posterior wall into the sphenomaxillary fossa, through the anterior wall under the skin of the cheek, through the floor into the mouth, or in several or all of these directions at the same time. The skin or mucous membrane finally gives way, and a fungating mass of bleeding cancer protrudes upon the cheek, in the nose, or in the mouth. After the cancer has reached the skin or mucous membrane the lymphatic glands become affected and the cancer is reproduced in distant organs.

Medullary cancer in the lower jaw commonly begins in the interior of the bone, and as it increases in size expands the walls of the jaw around it, and finally protrudes through the skin or through the mucous membrane into the mouth. The lymphatic glands and distant organs may be affected in the same way as in cancer of the upper jaw.

In upper jaw. XXIII. 8.—Part of the right side of a face, in which the antrum and other nasal cavities and passages are completely filled by a soft medullary tumour, which also projects with an extensive sloughing surface through the skin of the cheek and through the anterior part of the gum and of the hard palate.

XXIII. 13.—The left side of a face with a soft medullary tumour filling the antrum, and thence extending into the nostrils and into the cavities of the mouth and orbit. The parts of the tumour which are exposed are broken and flocculent, as if sloughing.

In the lower jaw. I. 208.—Portion of a lower jaw, comprising one side of the bone from the angle to the symphysis, which was removed by operation from a young woman. A soft medullary growth, originating in the interior of the bone, has caused the expansion of its

surrounding walls. In the upper half of the section the morbid structure has been separated from the cavity in which it was embedded.

CYSTS IN THE JAWS.

True cysts in the jaws must be distinguished from cysts due to cystic degeneration of other tumours. They may occur in the upper or the lower jaw, and may be either simple or multilocular. They can often be traced to the irritation of a decaying tooth fang, or to the faulty development of a tooth (see *Dentigerous Cysts*). In the upper jaw they generally appear to originate in the dilatation of one or more of the follicles of the mucous membrane lining the antrum; as they enlarge they expand the walls of the antrum around them, encroaching upon surrounding parts like solid tumours. In the lower jaw they appear to begin in the endosteum lining the bone. Whether they occur in the upper or the lower jaw they expand the bone around them until it in some cases becomes so thin that it crackles under pressure like parchment, and in places may be completely absorbed, leaving nothing but the membranous cyst-walls. The cysts are commonly lined with a vascular membrane; they usually contain serum, or a glairy fluid like white of egg, or in some instances a brownish fluid containing crystals of cholesterine.

I. 308.—An inferior maxillary bone, in greater part of its extent irregularly expanded to form imperfect septa between cysts. These, independent of one another, had their origin in the interior of the bone, were lined with a highly vascular membrane, and contained thin, serous, or grumous blood-tinged fluid. Of some the walls were thin, of some thick and resisting, as in the case of the posterior mass, which in its increase pressed upon and caused absorption of the left ascending ramus and coronoid process.

This preparation was obtained from the body of an old man. The disease had been some years in progress. The age of the patient prohibited its removal, but the various cysts were from time to time punctured and their contents evacuated.

Dentigerous Cysts.

Dentigerous cysts are collections of serum, or some modification of serum, occurring in the maxillary bones, associated with, and dependent upon, impacted misplaced teeth (Salter). When a tooth is completely developed its fang will be found embedded in its bony socket, while its enamel will be immediately surrounded, and separated from the jaw, by a soft membrane which was formerly part of the enamel organ. When from some cause or other the

cutting of the tooth is delayed a small quantity of serous fluid is secreted by this membrane, slightly separating it from the enamel. "This fluid ordinarily is discharged when the tooth is cut, but when from some cause the eruption of the tooth is prevented it increases in quantity, gradually distending the surrounding tissues in the form of a cyst" (Heath).

The cyst thus formed appears lined by a thick soft membrane, and the crown of the tooth, the fang of which is embedded in the bone, will commonly be found projecting into its deeper part. Occasionally, however, the tooth may be found loose in the cyst or but slightly attached to the lining membrane; in such a case the tooth socket has been encroached upon and absorbed by the pressure of the cyst. Dentigerous cysts are nearly always developed in connection with the *permanent* teeth. They must be distinguished from cysts depending upon the irritation of a decayed tooth fang; in the latter the fang will commonly be found associated with or projecting into the cyst, whereas in the dentigerous the crown alone, or the whole of the tooth in cases where the bony socket has been absorbed by the pressure of the cyst, will be found in the inside of the cyst.

I. 119.—Portion of a bony cyst which was removed from the external and lateral part of a lower jaw. The cyst is lined by a thick and soft membrane, which has been in part separated from it. The cavity of the cyst was filled by a glairy fluid, and at the bottom of it a canine tooth of the second set was adherent to the lining membrane. Upon the exterior of the cyst are some branches of the facial nerve which were removed with it. At the bottom of the bottle is the tooth which was contained in the cyst.

I. 119 (a).—Part of a bony cyst formed by expansion of the walls of the lower jaw of a sheep. The cyst was full of fluid, and an incisor tooth is loosely attached to its walls.

DISEASES OF THE PALATE.

NECROSIS OF THE HARD PALATE.

Necrosis of the hard palate is usually of syphilitic origin. It is due either to ulcerative destruction of the soft structures covering the palate, or to the breaking down of a gumma under the periosteum. After the necrosed portion of the palate has been exfoliated, a communication is generally established between the nose and the mouth.

The following specimen illustrates the deleterious effects produced by endeavouring to stop such a perforation by a plug.

I. 232.—The base of a skull, from an elderly woman, who appeared to have been long in the habit of wearing a plug to close an opening in

the palate, probably of syphilitic origin. The opening, gradually enlarging, attained such a size that nothing remains of the palatine portions of the superior maxillary and palate bones, and the alveolar border of the jaw is reduced to a very thin plate without any trace of the sockets of the teeth. The antrum is on both sides obliterated by the apposition of its walls, its inner wall having probably been pushed outwards as the plug was enlarged to fit the enlarging aperture in the palate. Nearly the whole of the vomer also has been destroyed, and the superior ethmoidal cells are laid open.

The plug is preserved. It is a large circular cork, with tape wound round it, and measures an inch and three quarters in diameter and an inch in depth.

TUMOURS OF THE HARD PALATE.

These are for the most part allied to the epuloid growths already described as affecting the gums, and like them consist of fibrous tissue, or of fibrous tissue intermixed with myeloid elements. They spring from the periosteum, and are covered with healthy mucous membrane. Spicula of bone growing out from the hard palate are frequently found in them.

Warty, fatty, and encysted tumours, as well as carcinomatous tumours both of the epithelial and medullary variety, have also been observed.

Fibrous tumours. XXIII. 6.—An elongated oval tumour removed from the palate, to which it appears to have been attached by a broad base. It is composed of a firm, very close-textured, obscurely fibrous substance, with interspersed specks of bone, like the epulis which more commonly grows from the gums.

Fatty tumours. XXIII. 22.—Sections of a tumour removed from the palate, to which it was attached by a base of much less extent than its circumference. Its surface is covered by thick, but apparently healthy, mucous membrane; and in its interior it appears composed of lobules of fatty matter.

TUMOURS OF THE SOFT PALATE.

These may be myxomatous, sarcomatous, carcinomatous, cystic or papillomatous in structure. A single specimen of the myxomatous is the only representative of these growths in the Museum.

The myxomatous are usually soft, pendulous, pedunculated, polypoid growths. They spring from the mucous membrane, usually in the neighbourhood of the uvula. The peduncle is often so long that it allows the tumour to fall into the larynx, giving rise to spasmodic cough, and sometimes even causing suffocation, as in the case of the patient from whom the following specimen was taken.

XXIII. 29.—Section of a boy's head with a large-lobed tumour, of myxomatous structure, in the soft palate.

The tumour was of slow growth. The patient was suddenly suffocated.

CONGENITAL MALFORMATIONS OF THE PALATE.

CLEFT PALATE.

Cleft palate is due to an arrest of development of the processes which normally grow inwards from the superior maxillary bones, and, meeting in the middle line, separate the cavity of the nose from that of the mouth.

The cleft is always in the middle line, and may involve the whole of the palate, or only a part of it. In the former case the fissure generally bifurcates in front, leaving the intermaxillary bone in the angle of bifurcation, and each fork of the fissure is continued in the course of the suture between the maxillary and intermaxillary bones, through the alveolar process of the jaw and through the lip on either side (double hare-lip); or the fissure may be deflected to one side, following the course of one of the above-mentioned sutures, and extend through the alveolar process and lip on one side only (single hare-lip), the intermaxillary bone in such cases remaining fused to the maxilla on the side opposite to the cleft. The septum, which is continuous in front with the intermaxillary bone, terminates in a free border in the middle of the cleft, or it may be attached to one or other margin of the cleft.

When the cleft of the palate is partial the cleft may be confined to the uvula, which then appears bifid; or to the whole of the soft palate; or to the whole of the soft and part of the hard palate.

In rare instances, only an aperture in the middle line of the hard palate may exist; or the fissure may be confined to the alveolar process on one or other side of the intermaxillary bone. The conditions of the muscles of the soft palate are well seen in one of the following specimens in which they have been dissected.

Series A. 9.—Head and limbs of a fœtus with hare-lip and a wide complete fissure of the palate.

Series A. 10.—The head of a fœtus with a wide fissure extending through the whole length of the palate and uvula. The lower border of the nasal septum projects into the middle of the fissure.

Series A. 10 a.—The head of a mature fœtus with a fissure extending through the entire length of the hard and soft palate and uvula. The tongue and larynx have been divided through the median line, and their halves are set apart. The muscles of the soft palate are dissected, and

bristles are passed beneath those of the right side. All the muscles occupied their natural positions. The palato-glossus was found proportionally larger than in the adult. The tensor palati was in its outer portion very short, the pterygoid plates appearing imperfectly developed; its inner portion did not appear fibrous. The azygos uvulæ was large, each half of the uvula having its proper muscle. The levator palati was large, and passed between some of the fibres of the palato-pharyngeus. The last-named muscle appeared normal.

Series A. 230.—A specimen showing a complete cleft of the hard and soft palate, extending through the alveolar process on the left side and the left nostril and left side of the lip; the intermaxillary bone is fused with the right maxilla.

DISEASES OF THE PAROTID GLAND.

The diseases of the parotid gland may be enumerated as parotiditis or mumps, abscess, salivary calculus, salivary fistula, and malignant, non-malignant, and cystic tumours. A few specimens of non-malignant tumours and salivary calculi are the only representatives of these affections in the Museum.

TUMOURS OF THE PAROTID.

Tumours of the parotid, when innocent, are generally composed of a mixture of cartilage and glandular elements. They may occur either in the substance of the gland itself, or merely upon it. They are generally encapsulated, of slow growth, and may attain a large size, in extreme cases even occupying the whole side of the neck. The skin, though non-adherent, becomes tightly stretched over them as they increase in size, and may finally ulcerate. They have frequently very deep attachments; thus, they may extend between the ramus of the jaw and internal-lateral ligament, or behind the styloid process, and may involve the blood-vessels and nerves situated in the substance of the parotid gland: they have even been known to extend to the pharynx. When completely removed they do not return. Their general appearance is well seen in the accompanying specimens.

Similar tumours, but containing myxomatous and sarcomatous elements, also occur in the parotid; these, unlike those above described, may return on removal.

Enlargement of the lymphatic glands situated over the parotid has been mistaken for tumours of the parotid.

XXXV. 45.—Section of a tumour removed from over the parotid gland of an apparently healthy woman about thirty years old. It is

nearly pyriform, measuring about three inches and a half in length and three inches in its greatest breadth. Its upper half is composed of white, semi-transparent, and compact cartilage; its lower half of a pale, obscurely fibrous, soft substance. The boundary between the two substances is clear, though in no regular line; for a few small portions of cartilage are seen embedded in the softer substance.

The tumour had grown very slowly and without pain. It was loosely connected with the surrounding parts.

XXXV. 16.—A tumour which was removed from the space between the ramus of the jaw and the ear. It was in part embedded in the parotid gland, small portions of which, together with several branches of the facial nerve, were removed with it and are attached to its surface. The tumour consists of a white, firm, and granulated substance, invested by a distinct thin capsule.

XXXV. 83.—Half of a large tumour removed from over a parotid gland. The tumour formed a somewhat kidney-shaped mass, with its concavity resting on the parotid and adjacent structures. It is composed of large lobes, the partitions between which are in many places ossified. Its cut surface has a generally ochre-yellow or fawn colour varied with paler tints, and with small nodules of cartilage and a few portions of bone-like grains embedded in it. Its substance is very firm, hardly compressible, but easily rending or breaking. A few small cysts lie scattered in it; a large cyst filled with fluid was connected with a part of the tumour, not shown here.

The patient was a woman sixty-five years old. The tumour had been slowly increasing for thirty-three years; and within the last year the skin over it had ulcerated, allowing a portion of it to protrude. It reached from just below the ear to the lower part of the neck, overhanging the clavicle; forwards it extended nearly to the median line, and backwards nearly to the margin of the trapezius. The patient's general health was not materially affected by it, and she recovered after its removal. But a portion left in the operation subsequently increased rapidly, and then ulcerated, and by discharge and pain destroyed life in about twelve months.

XXXV. 84.—Section of a tumour, of the same kind as that last described, and also removed from over a parotid gland. It is oval, deeply knobbed, measuring about an inch and three quarters by an inch. In general aspect its cut surface resembles that of the preceding tumour. It is more distinctly shown to be invested with a thin layer of fibro-cellular tissue.

The patient was a woman forty-eight years old. The tumour had been increasing without pain for three years. In microscopic structure it consisted of a tissue like that of glands, and of cartilage with groups of well-formed cartilage-cells and of free stellate and spicate nuclei.

XXXV. 85.—Section of a tumour of the same kind removed from a similar situation. In this, however, the cartilaginous predominates over the glandular constituent of the morbid structure.

The patient was a woman twenty-five years old. The tumour had

been observed twelve months. Its increase was regular and painless. About six weeks after this operation another tumour of the same kind appeared, which was removed after eleven months' growth. No subsequent growth occurred for at least three years.

The microscopic characters of this tumour were essentially similar to those of the last described.

SALIVARY CALCULI.

Calculi are occasionally found in the ducts of the salivary glands. They are generally composed of animal matter impregnated with phosphate of lime, and a trace of carbonate of lime. They are commonly of an elongated form, and may attain a considerable size; they have been found measuring more than an inch in length.

XXXVII. 25.—Two small calculi from a parotid duct.

XXXVII. 26.—Three calculi which were removed from the submaxillary duct.

XXXVII. 27.—A minute calculus removed from the submaxillary duct of a child.

XXXVII. 28.—A calculus from the submaxillary duct of an old man, the grandfather of the child from whom the preceding specimen was taken.

XXXVII. 46.—A very large calculus removed from a woman's submaxillary duct. A portion of it was crushed in the extraction. When entire it measured an inch and a half in length and a third of an inch in diameter. Its composition is bone-phosphate of lime with animal matter, and a trace of carbonate of lime.

DISEASES AND INJURIES OF THE TONGUE.

HYPERTROPHY.

Hypertrophy of the tongue is a disease of early life; it is often congenital. The hypertrophy, which chiefly affects the anterior part of the tongue, may be so considerable as to cause displacement of the teeth, and even in extreme cases to occasion suffocation.

A variety of hypertrophy is described by Virchow as consisting in the dilatation of the lymphatic spaces of the tongue with clear serous fluid.

XXIII. 34.—A horizontal section of a portion of an hypertrophied tongue removed by the *écraseur* from a child aged three years. The tongue had increased in size since the age of sixteen months.

The portion removed always protruded from the mouth. The child never complained of it, but could masticate without trouble and talk very well. The lower teeth, however, had become pushed downwards

and pointed unnaturally outwards from the pressure above. The structure seems to be that of healthy tongue, lingualis muscle with a thickened mucous membrane.

SYPHILIS.

There are no specimens of syphilitic affections of the tongue in the Museum.

CANCER.

Cancer of the tongue is nearly always epithelial; some authors affirm always. Scirrhus cancer of the tongue, however, does occasionally occur.

Epithelial cancer commonly begins on one side of the anterior part of the tongue, and can often be attributed to the irritation of the sharp crown of a tooth. At first it appears as a small ulcer or fissure, with indurated edges, or as a flattened indurated tubercle. Scirrhus cancer begins as a hard nodule, more deeply seated in the substance of the tongue. As the disease advances the ulcer or fissure spreads, or the tubercle or nodule undergoes ulceration. At this stage the ulcer is generally of irregular form, with indurated, everted, and sinuous edges, a hard base and ragged, sloughy surface. The submaxillary lymphatic glands become affected and the cancer involves the whole tongue and spreads to the adjacent parts.

It is often difficult to distinguish cancerous from syphilitic affections of the tongue. The general appearance of the tongue, the condition of the glands, the results of the treatment, the age and history of the patient, are the principal points to be attended to in the diagnosis.

XXIII. 18.—A larynx, with part of the pharynx and palate, and the remains of a tongue. Nearly the whole of the tongue has been destroyed by cancerous ulceration. Its base and a small portion of the left side alone remain; and the ulceration which has exposed them has also spread in the tissues beneath the tongue, nearly as deep as the os hyoides. The tissues around the ulcerated parts are hardened, consolidated, and confused, and have cancerous matter infiltrated in them.

XXIII. 19.—A tongue, with the larynx and other adjacent parts. A large cancerous growth, formed in the base of the tongue, has been exposed by a section carried through the right side of the tongue from before backwards. Part of it has softened, and the centre of its surface has ulcerated, forming a large ulcer with elevated, sinuous, and everted margins. The larynx has been œdematous; its mucous membrane is wrinkled.

XXIII. 37.—Tongue of a man, aged fifty-five, removed by Syme's operation of dividing the symphysis of the lower jaw and removing the

whole organ with the knife. The tongue is completely infiltrated with epithelial cancer, and a deep longitudinal fissured ulcer is to be seen on its superior surface. The disease had existed for nine months.

XXIII. 36.—Cancerous ulceration of the tongue, from a man, aged forty, who died suddenly after one profuse hæmorrhage. The disease had existed five months. The whole right half of the tongue had been destroyed quite to the root. Another surface of the ulcer was in a sloughing state. Immediately in front of the anterior palatine arch the ulcer communicates with a distinct cavity, with sloughing walls, below the submaxillary gland and beneath the hypoglossus muscle. Into this cavity the lingual artery opens about three quarters of an inch beyond its origin. A bristle has been passed from the carotid through the lingual artery into the cavity, and another from the cavity through the opening into the mouth.

XXIII. 11.—Sections of a carcinomatous tongue. The disease is situated in the base and centre of the tongue, and a hard tubercle projects on its upper surface. The diseased structure is very firm, irregularly intersected by white lines, and closely blended with the surrounding muscular substance. The left tonsil is ulcerated, and a bristle is passed through an artery distributed to it, from which a considerable hæmorrhage occurred just before death.

TUBERCULAR ULCERATION.

The tubercular ulcer of the tongue may generally be distinguished from cancer by its uneven granulated base, its inverted, undermined edges, and the absence of induration and glandular enlargement. The following is apparently a specimen of this affection.

XXIII. 28.—The right half of a tongue, on the border of which is an ulcer with an uneven, coarsely granulated base, and an inverted and somewhat undermined margin. It has destroyed the whole thickness of the mucous membrane of the tongue, exposing at irregular depths the muscular tissue.

The patient, a man thirty-seven years old, died with advanced tuberculous disease of the lungs and larynx. The ulcer of the tongue was of eight months' duration. For a short time before his death it appeared to be healing, but before this time it had presented so close a resemblance to the common tuberculous ulcer of the intestines that it was believed to be of tuberculous nature. The coexistent disease in the lungs and larynx, and the absence of any cancerous structures near the ulcer, further justified this belief.

FATTY DEGENERATION.

XXIII. 32.—A tongue, reduced to fat, from a case of progressive muscular degeneration. The subject was a man, aged sixty, who had gradually lost health and strength for two and a half years before he

died. At the same time speech and the first act of deglutition failed, and he was compelled at last to communicate all wants in writing, and to force food within the grasp of the arches after mastication by means of a common spatula. The tremulous twitchings of the muscles of the tongue, and eventually of others, were remarkable. Becoming slowly emaciated from imperfect nutrition, he died without additional symptoms. The nerve-centres, the nerves, and the organs generally, were examined after death, and presented a natural appearance. The tongue is converted into a mass of fat, and some other of his muscles showed symptoms of the same disease in its earliest stages.

ENCYSTED TUMOURS.

Ranula.

A ranula is a semi-transparent, bluish-white swelling situated under the tongue, containing a glairy mucoid fluid. It is produced by the enlargement of one of the mucous glands so abundant in that situation. It was formerly thought to be a dilatation of the submaxillary duct. There is no specimen in the Museum.

Sebaceous cysts.

Encysted tumours containing sebaceous-looking material are occasionally found under the tongue. They are generally congenital, and often attain a large size, frequently extending into the neck and projecting as large semi-fluctuating tumours between the chin and hyoid bone. A specimen follows.

XXXV. 25.—A cyst, with thin, tough walls which was removed from beneath the tongue. It projected into the mouth, and extended so far downwards as to be prominent in the front of the neck. Its contents are a firm, grumous, and granulated suet-like substance.

INJURY OF THE TONGUE SUSTAINED IN AN EPILEPTIC FIT.

The tongue is frequently lacerated by the teeth in epileptic fits. In the following specimen the tip was completely bitten off.

XXIII. 5.—The anterior half of a tongue, which was bitten off in an epileptic fit.

The patient recovered and retained the power of articulation.

DISEASES OF THE TONSILS, FAUCES, AND PHARYNX.

CHRONIC ENLARGEMENT OF THE TONSILS.

Chronic enlargement of the tonsils is generally the sequel either of chronic or often-repeated attacks of acute inflammation of the tonsils. The enlargement usually consists in a uniform hypertrophy of the adenoid tissue of the organ, but occasionally it is produced by a distinct outgrowth from the tonsil, which it resembles in structure. The mucous membrane covering the enlarged tonsil is thickened, and either hypervascular and purplish-red, or anæmic and whitish in appearance; its surface is uneven and dotted with small pits and depressions (the mouths of enlarged follicles) filled with a sticky sebaceous secretion. The presence of this secretion gives the tonsil the appearance of being superficially ulcerated, a condition which sometimes actually exists.

The enlarged tonsil is firm and semi-elastic to the touch. On section, the fibrous adenoid tissue appears greatly increased, and the follicles enlarged and filled with accumulations of retained secretions and epithelial débris.

XXIII. 41.—Portion of a large tonsil, removed by operation.

XXIII. 1.—A tongue, with the soft palate and its arches, exhibiting an enlargement of the right tonsil, with deep and ragged ulceration of its substance.

XXIII. 31.—A tumour, which commenced in the right tonsil and grew out into the fauces. It was removed from a man, aged forty, and had existed eighteen months. More than a year previously a considerable portion of the right tonsil had been excised. In its general characters and structure it resembled the tonsils.

ULCERATION OF THE FAUCES, TONSILS, AND PHARYNX.

The pillars of the fauces, the tonsils, and the back of the pharynx are very subject to ulceration. The ulceration may follow simple inflammation, as in the ordinary ulcerated sore throat, or it may depend upon syphilis, scrofula, or scarlet fever.

Syphilitic ulceration. XXIV. 8.—The base of a tongue, with the pharynx and other adjacent parts. A large portion of the mucous and submucous tissues of the pharynx, and of one margin of the epiglottis, is destroyed by sloughing and ulceration. The mucous membrane covering the upper part of the larynx is œdematous and, in some parts, superficially ulcerated.

From a girl who was greatly debilitated by the effects of syphilis and mercury.

XXIII. 17.—A tongue and pharynx, exhibiting extensive sloughing of their mucous membrane, which was considered to be the effect of mercury administered to a syphilitic patient.

XXIV. 7.—Part of a pharynx and œsophagus, with the larynx. The mucous membrane of a part of the pharynx and œsophagus is destroyed by ulceration. The surface of the ulcer is uneven and ragged, and in one point, marked by a bristle, the ulceration extends through the adjacent lateral wall of the trachea.

Ulceration from scarlet fever. XXIV. 16.—The pharynx, larynx, and other adjacent parts of a child who died with scarlet fever. The mucous membrane of the pharynx and upper part of the œsophagus is extensively and deeply ulcerated. Some of the ulcers are isolated, and are quite irregular in form; others have coalesced; in both cases their arrangement is exactly symmetrical. The tissues beneath and adjacent to the ulcers are thickened and œdematous.

Cause of ulceration not stated. XXIII. 30.—The larynx and adjacent parts, removed from a man who died under the following circumstances:—He was a soldier, and was admitted into the Military Hospital with a sloughing ulcer of the throat, but without venereal taint. There was a considerable loss of substance, and his condition for many days was most critical. He improved under treatment, and all that could be seen of the ulcer healed, and the patient rapidly gained flesh. He was considered convalescent. While sitting up in the ward his mouth was suddenly filled with blood; he ejected about a pint of bright arterial blood, and died before he could reach his bed. On examination after death it was found that, although the ulcer on the soft palate and back of the pharynx had healed, a small aperture existed behind the remains of the left tonsil, which led downwards into a pouch of elongated form, the lining of which was still ulcerated. At the bottom of this pouch a small clot was found adherent, and by carefully tracing the branches of the external carotid it was found that the superior thyroid artery opened into the cavity, and thus caused fatal hæmorrhage.

CANCER OF THE FAUCES, TONSILS, AND PHARYNX.

Cancer in these situations is usually epitheliomatous or medullary. Whether it begins at the base of the tongue, in the tonsils, fauces, or wall of the pharynx, it rapidly involves the adjacent parts, converting them into a confused mass of cancer. Ulceration of the cancerous mass follows, and an irregular cavern with hard and everted edges is the result.

XXIII. 2.—The base of a tongue, with parts of the fauces, pharynx, and larynx. Deep and extensive ulceration, which appears to have succeeded the growth of a large medullary tumour, has destroyed the epiglottis, the folds connecting it with the arytenoid cartilages, the base of the tongue, and parts of the arches of the palate. The ulceration is bounded below by the superior vocal cords.

XXIII. 3.—A larynx, with part of the fauces. A large growth of soft medullary substance, partially ulcerated, covers the base of the tongue, the soft palate, the tonsils, and the upper and posterior wall of the pharynx.

XXIV. 17.—A pharynx, with the tongue and other parts. A tumour of almost globular form, and nearly an inch in diameter, is situated in the fold of membrane connecting the side of the epiglottis with the right arytenoid cartilage and lining the adjacent wall of the pharynx. It is loosely fixed, so that it might hang either in the right side of the pharynx or above and nearly closing the superior aperture of the larynx. A section of it shows that its interior is lobulated, soft, elastic, and obscurely fibrous, like a medullary tumour. A small portion of its surface has sloughed. All the adjacent part of the mucous membrane is deeply wrinkled, the fluid which caused the œdema having escaped.

XXIV. 18.—A pharynx and larynx, with the base of the tongue and other adjacent parts. A large ulcer, destroying a great part of the lower portion of the pharynx, has extended into the trachea directly below the cricoid cartilage. The margins of the ulcer are sharp and abrupt; its base is irregular, and was covered with a soft creamy matter, containing the *débris* of epithelial cancer.

DISEASES AND INJURIES OF THE ŒSOPHAGUS.

INFLAMMATION.

Inflammation of the œsophagus is rare. When it occurs it is generally from traumatic causes, such as swallowing boiling water, strong acids, alkalies, &c. Inflammation, diphtheritic or other, of the pharynx, has been known to spread downwards to the œsophagus. A catarrhal inflammation of the mucous membrane of the œsophagus is also occasionally met with.

From swallowing nitric acid. XXIV. 20.—An œsophagus; its mucous membrane shrivelled; of a bright yellow colour, and thrown into longitudinal folds. The yellow discoloration stops abruptly with an irregular, jagged border at the commencement of the stomach, the epithelial and mucous coats of which are wanting, its surface being rough and of a brownish-red colour.

From the body of a man who died fifteen hours after drinking one ounce of strong nitric acid. A drawing of the stomach and œsophagus is preserved in the Museum, No. 92.

From swallowing sulphuric acid. XV. 9.—The stomach and œsophagus of a person who died in consequence of having taken sulphuric acid. The deep red colour, mottled with black, and extending throughout the interior of the stomach, is occasioned by blood effused from the eroded vessels and acted on by the acid. The greater part of the mucous membrane is destroyed, and the surface exposed is rough and shaggy.

In the œsophagus and near the pyloric end of the stomach, portions of the mucous membrane remain, and are red, thick, and corrugated.

From diphtheria (P). XXIV. 6.—An œsophagus, in which the whole of the mucous membrane is covered by a uniform, thin layer of inflammatory material. Strips of the inflammatory material, which is soft as if recently effused, is reflected. In the portion of the pharynx which is preserved, inflammatory material of the same kind is deposited in separate patches.

The patient was a man thirty-five years old. He died on the seventh day of acute pleuro-pneumonia. No sign of this affection of the pharynx and œsophagus had been observed during life, and it is not probable that he had taken any large quantity of antimony.

See also XXIV. 11.

STRICTURE.

Three forms of stricture of the œsophagus are described—the spasmodic or hysterical, the fibrous or simple, and the cancerous or malignant. The lumen of the œsophagus, moreover, may be diminished by the pressure of aneurisms, tumours, &c., external to the tube. Spasmodic stricture, which is due to the contraction of the muscular fibres of the œsophagus, will not receive further notice.

The usual situations of stricture are opposite the cricoid cartilage, opposite the bifurcation of the trachea, and at the entrance of the œsophagus into the stomach—situations where a slight contraction of the tube naturally exists.

In the fibrous and the more chronic forms of malignant stricture the œsophagus above becomes dilated and its muscular coat hypertrophied, while the part below tends to become smaller.

Fibrous stricture.

Fibrous stricture is due to the contraction of cicatrices following the destruction of the mucous membrane by corrosive poisons, strong acids, strong alkalies, or boiling water; or to the contraction of inflammatory material which has been produced in the sub-mucous tissue as the result of syphilis or of the irritation set up by the impaction of a foreign body.

XXIV. 1.—A pharynx and œsophagus, with the larynx and other adjacent parts. Just below the lower border of the cricoid cartilage, the canal of the œsophagus is reduced to a quarter of an inch in diameter, and appears flattened from before backwards. The tissues for some distance around this part are thickened, indurated, and consolidated. The mucous membrane of the anterior wall of the pharynx above the stricture is ulcerated, and appears œdematous, as if an

abscess had been discharged through it. Below the stricture the œsophagus is healthy.

Cancerous stricture.

Cancer of the œsophagus is usually of the epitheliomatous, occasionally of the schirrhous, and rarely of the medullary or the colloid type.

Epithelial cancer.—Epithelial cancer may begin as a distinct cauliflower-like excrescence springing from one side of the tube; or as a nodular induration of the mucous membrane, involving ring-like the whole circumference of the œsophagus. By some it is thought to be often secondary to a fibrous stricture. In whatever way the cancer begins, it gradually encroaches upon the lumen of the œsophagus, and eventually causes a more or less complete obstruction. Ulceration of the cancerous mass at length sets in, giving rise to a foul cavernous-looking ulcer with indurated and sinuous edges. As the ulcer spreads it may involve the mediastinum or pleuræ, or eat its way into the trachea, bronchi, or larynx. The corresponding lymphatic glands often become enlarged, but distant organs remain unaffected. Epithelial cancer is most common opposite the cricoid cartilage, the bifurcation of the trachea and the entrance of the œsophagus into the stomach.

XXIV. 18.—A pharynx and larynx, with the base of the tongue and other adjacent parts. A large ulcer, destroying a great part of the lower portion of the pharynx, has extended into the trachea directly below the cricoid cartilage. The right half of the cricoid cartilage is denuded and separated from its connections with the upper ring of the trachea; on this side, also, a portion of the thyroid cartilage is exposed. The margins of the ulcer are sharp and abrupt; its base is irregular, and was covered with a soft, creamy matter, containing, probably, the *débris* of epithelial cancer.

XXIV. 2.—The lower half of an œsophagus, with the cardiac portion of the stomach. Within and just above the cardiac orifice there is an annular, flat, spongy growth, ulcerated in its centre; by which growth, as well as by the thickening and contraction of the surrounding tissues, the termination of the canal of the œsophagus is reduced to a very small calibre. Above the stricture the œsophagus is dilated, its muscular coat is hypertrophied, and its mucous membrane appears œdematous, and is at one part superficially ulcerated. The walls of the stomach are healthy.

XXIV. 4.—An œsophagus and stomach. The lower third of the œsophagus and a large portion of the stomach, near its cardiac orifice, are ulcerated through the whole thickness of their walls. The margins of the ulcer are sinuous, very abrupt and ragged, and present the general aspect of cancerous disease.

XXIV. 24. An œsophagus from a man aged fifty-six, showing an

epithelial cancer in a state of ulceration involving the whole circumference of the tube in its lower third. At one part the coats are entirely perforated, and the tube of the œsophagus communicated with an ulcerated cavity which lay in the tissue of the posterior mediastinum in contact with the right lung. No disease was found elsewhere.

XXV. 43.—A larynx with part of the trachea, pharynx, and œsophagus, from a woman aged forty-nine. The specimen shows a large ulcer, two inches across, nearly round, almost surrounding the gullet, possessing very thick cancerous margins, on a level with the top of the manubrium sterni, and opening into the trachea by a hole the size of a sixpenny-piece.

Scirrhus cancer.—Scirrhus cancer of the œsophagus probably begins in the submucous tissue. It appears as a hard, nodular infiltration of the coats of the œsophagus, rendering the walls of that tube rigid and unyielding, and gradually producing, by its contraction and shrinking, complete obstruction of the canal. The neighbouring parts and distant organs sooner or later become affected by the cancer and ulceration of the mass finally ensues, as in the epitheliomatous form.

XXIV. 3.—Part of an œsophagus, with the trachea and bronchi. Opposite the bifurcation of the trachea the walls of the œsophagus are nearly surrounded by a firm cancerous growth. The surface of this growth where it projects into the œsophagus is ulcerated, and ulceration, penetrating at one part through its whole thickness, has extended into the right bronchus, in the course indicated by the piece of quill.

Medullary cancer.—Medullary cancer generally occurs as a distinct tumour projecting into the œsophagus. It grows more rapidly than the other forms of cancer, and involves sooner and more frequently the neighbouring parts and distant organs. It is very rare.

XXIV. 5.—A pharynx, with the soft palate, and part of the base of the skull. The upper part of the pharynx is completely filled by a nearly globular growth of soft medullary substance with a warty surface. The growth appears to have had its origin in the walls of the pharynx, from which it projects, not only into the pharyngeal cavity, but also forwards into the mouth under the soft palate, and backwards towards the spine.

The patient was not aware of the existence of the tumour till within a few weeks of his admission into the hospital, at which time it was nearly as large as it now appears. It often bled, and it destroyed life by the hæmorrhage, and by the impediment which it caused both to deglutition and respiration. A part of the same tumour projected through the basilar portion of the occipital bone, and extended along the outside of the œsophagus, where it was connected with enlarged lymphatic glands full of soft cancer.

Colloid cancer.—Colloid cancer of the œsophagus is very rare. A specimen follows.

XXIV. 19.—Part of an œsophagus, in which nearly the whole of the submucous tissue is occupied by a substance resembling that of colloid cancer. In many places the mucous membrane is upraised, with a low tuberculated surface, by the colourless and nearly pellucid clustered cystic growths beneath it; and at one part a globular mass of the same structure, about two-thirds of an inch in diameter, is suspended from the submucous tissue into the cavity of the œsophagus.

Condition simulating stricture of the œsophagus.

XXIV. 12.—An œsophagus, trachea, and adjacent parts, exhibiting the remains of an abscess which had formed in the deep cellular tissue of the neck, and by its pressure upon the upper part of the œsophagus had caused pain and difficulty in swallowing. The abscess has burst into the œsophagus and cavity of the right pleura.

XXIV. 15.—Portion of the œsophagus of an elderly woman. The whole of the tissues and a part of its anterior surface are penetrated by an ulcer of an oval form with irregular edges. The base of the ulcer is formed by a mass of bronchial glands.

DILATATION OF THE ŒSOPHAGUS.

Dilatation of the œsophagus is generally consequent upon some form of stricture, the dilatation being limited to the portion of tube above the obstruction. In rare instances, however, the whole tube has been found uniformly dilated, even to the size of a man's arm, without any very evident cause; some, however, have thought the dilatation to be dependent upon muscular paralysis induced by chronic catarrh or ulceration of the mucous membrane. The muscular walls in such a case are usually hypertrophied, but occasionally thinned, and the mucous membrane is healthy or superficially ulcerated. When consequent upon stricture the dilatation is greatest immediately above the obstruction, and gradually decreases towards the upper end. Sometimes the dilatation is confined to limited portions of the œsophageal walls, giving rise to outgrowths or diverticula, which may consist either of a protrusion of all the coats or of a hernia of the mucous membrane between the fasciculi of the muscular fibres.

General dilatation. XXIV. 12.—An œsophagus with a portion of the stomach. A dilatation of the œsophagus commences immediately below the larynx, and gradually increases to its termination in the stomach. In its lowest half the œsophagus measured nearly six inches in circumference. In the upper half of the dilated œsophagus the lining membrane is sound; at its lower half the greater part of this membrane is superficially ulcerated, and shreds of it hang in the

interior of the tube. Just above the stomach, the complete removal of the lining membrane exposes the muscular fibres of the œsophagus, which are here, and on every part of the canal, hypertrophied. The passage from the œsophagus into the stomach was free, and the stomach was healthy. The patient was twenty years old. He had signs of this disease for about eighteen months before his death, with frequent sickness about two hours after taking food, pain and tenderness in the epigastric region, and a feeling as if his food stopped at the lower part of the œsophagus. He died with peritonitis.

Dilatation from stricture. XXIV. 2.—The lower half of an œsophagus exhibiting a stricture just above the cardiac portion of the stomach. Above the stricture the œsophagus is dilated, and its muscular coat is hypertrophied.

POST-MORTEM DIGESTION.

The œsophagus, like the stomach, is liable to undergo post-mortem digestion. Such a condition may be readily distinguished by the characteristic ragged, flocculent and pulpy appearance of the edges of the digested portion from ante-mortem ulceration, in which the edges of the ulcer are generally smooth, even, and indurated.

XXIV. 10.—An œsophagus with a small portion of the stomach. About half the circumference of the walls of the œsophagus at its lower end is thin, soft, and pulpy, and in the centre of this part there is a large aperture with ragged flocculent margins partially blackened. The adjacent parts of the œsophagus and stomach are healthy.

XXIV. 13.—An œsophagus with a portion of the stomach. There is almost entire destruction of the coats of the œsophagus for three inches above the stomach, and in nearly the whole circumference of the tube. The portion of the œsophagus which remains in this situation is pale, soft, and pulpy. The stomach appeared healthy.

RUPTURE OF THE ŒSOPHAGUS.

XXIV. 9.—An œsophagus and stomach, exhibiting an extensive laceration of the muscular fibres of the former, which occurred in the act of vomiting. Both layers of the muscular fibres of the œsophagus are torn through at their connection with those of the stomach; and, by their retraction towards the upper part of the œsophagus, its submucous tissue is exposed over the whole extent of its last four inches. A similar retraction of the muscular fibres on the fundus of the stomach has taken place, exposing a large portion of its submucous tissue. There is a small laceration of the mucous and submucous tissues of the œsophagus about two inches from the cardia.

The patient was a man sixty-five years old. For about a year before his death he had dyspepsia, and was believed to have stricture in the lower part of the œsophagus, for which probangs were passed. He was subject to vomiting, and could not swallow anything solid. He felt the rupture of the œsophagus during a slight act of vomiting, thirty-six

hours before death. There is no appearance of stricture or of any change of structure having existed in the œsophagus previous to the rupture.

IMPACTION OF FOREIGN BODIES.

Foreign bodies, such as a piece of meat, a fish bone, a coin, or artificial teeth, frequently become impacted in the œsophagus. The impaction generally occurs at the commencement of the œsophagus opposite the cricoid cartilage, or at its termination where it passes through the diaphragm into the stomach. If the foreign body be not removed ulceration, or, in the case of a sharp substance such as a pin or fish bone, perforation of the œsophageal walls may ensue, leading to suppuration in the neighbouring parts, or even to perforation of one of the large blood-vessels or air-tubes. In other instances the foreign body may become embedded in the walls of the œsophagus, and there remain quiescent for months or even years.

Injuries sustained by the impaction are liable to lead to stricture.

XXIV. 22.—Part of an œsophagus and pharynx with the surrounding structures. At the commencement of the former, just below the level of the cricoid cartilage, a fragment of bone, fixed across the axis of the canal, has its pointed extremities embedded in an ulcerated and sloughing mucous membrane.

On either side of the pharynx are cavities which contained pus, surrounded by sloughing tissue. One of these, on the right side, extends between the œsophagus and the trachea. These abscesses communicate freely with the ulcers which surround the impacted extremities of the foreign body.

XXIII. 33.—A set of artificial teeth, of which this is a model, slipped into the fauces of a man during syncope or a slight epileptic fit, and remained fixed between the root of the tongue and the epiglottis for fourteen weeks, occasioning great difficulty of deglutition and other distressing symptoms. It was at length extracted.

INJURIES AND DISEASES OF THE ABDOMINAL VISCERA.

INJURIES SUSTAINED IN THE OPERATION OF PARACENTESIS.

XVI. 128.—Two specimens from a case in which fatal hæmorrhage followed the operation of paracentesis. In the upper a coloured clot is seen to project into the peritoneal sac from the inner orifice of a puncture made by a trochar in the ordinary situation. The patient died twelve hours after. The sac was filled with blood.

In the lower the anterior wall of the abdomen has been removed. On

one side is seen the omentum, in which are many large veins; on the other, the thick wall of the ovarian cyst. In puncturing the latter, which was one of many resulting from a colloid growth, the trochar passed through a vein belonging to the omentum, which latter was spread over the front of the cysts between them and the abdominal wall. The sac of the peritoneum and that of the punctured cyst contained fluid and coagulated blood. The patient died a few hours after the operation.

XVIII. 25.—Portion of a liver, the anterior portion of which was punctured by a trocar. The wound was made a fortnight before death in puncturing a cyst connected with the pelvis of the kidney. No ill-consequences were apparent.

RUPTURE OF THE ABDOMINAL VISCERA.

Rupture of the abdominal viscera is generally the result of great violence; as a common cause may be mentioned a squeeze between the buffers of railway carriages.

Rupture of the stomach is sometimes produced by a blow upon the abdomen while the stomach is distended with food.

Rupture of the liver.

XVIII. 1.—Portion of the liver of a child, deeply and extensively lacerated by a blow upon the abdomen.

Rupture of the gall-bladder.

XIX. 14.—A gall-bladder, in which there is a rent about three quarters of an inch long, extending through all its coats, close to its attachment to the liver.

From a man fifty years old, who was kicked near the region of the liver while stooping. He died in fifteen hours. The gall-bladder appears to have been distended in consequence of a small calculus in its neck.

Rupture of the spleen.

XXII. 5.—The spleen of a child, deeply and extensively lacerated by a blow on the abdomen.

Rupture of the stomach.

XV. 22.—Portion of a stomach and duodenum. There is an irregular aperture, more than an inch in width, extending through all the coats of the stomach near the pylorus. In several other parts the peritoneal coat is irregularly torn. These injuries were produced by the crushing of the abdomen, the stomach at the time being full of food.

XV. 18.—Portion of the stomach and œsophagus of a middle-aged man, who, it was supposed, had attempted to poison himself with laudanum. There is an extensive laceration through all the coats of the stomach a little beyond the entrance of the œsophagus. These

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lacerations were the effects of over-distension, the stomach-pump having been too freely used for the removal of the poison.

Rupture of the small intestines.

XVI. 51.—Portion of an ileum, exhibiting a complete transverse rupture of its coats. A thin shred alone connects the two portions. The result of external violence.

Rupture of the mesentery.

XVI. 141.—Mesentery and portion of small intestine from a boy, aged eleven, who fell between the side of a cart and its wheel, and was dragged along for some distance. He died from peritonitis, and on examination a rent of the mesentery was found, about three and a half inches in extent. The coil of intestine corresponding to part of the rent in the mesentery was folded on itself, of a dark claret colour, sodden and oedematous, and united to adjacent parts by bands of recent lymph. This portion of intestine looked as if dead, and it seemed doubtful whether its condition was due to altered blood-supply, in consequence of the rent in the mesentery, or to direct injury. The subperitoneal tissue of the abdominal wall situated over the portion of intestine was infiltrated with blood.

IMPACTION OF A PIN IN THE VERMIFORM APPENDIX.

XVI. 137.—Appendix vermiformis, from a man, aged forty-three, who died of abscess in the brain and liver. The point of a pin may be seen protruding from it into the cæcum, while the head is embedded in a mass of hardened fæces. There was no sign of ulceration, or of either recent or old peritonitis.

INTESTINAL OBSTRUCTION.

The conditions which may give rise to intestinal obstruction are very numerous: they are generally divided into the *acute*, which are productive of sudden and complete obstruction, are attended with acute symptoms, and if not soon removed, prove rapidly fatal; and the *chronic*, which are productive of gradual obstruction, are attended by less alarming symptoms, and although frequently fatal, may, either spontaneously or as the result of treatment, terminate favourably.

The conditions which commonly give rise to acute intestinal obstruction may be classed as—

1. Impaction of foreign bodies in the intestine, such as gall-stones.
2. Internal strangulation, *i. e.*, obstruction in consequence of a loop of intestine becoming strangulated in a hole in the omentum or mesentery, or by bands of adhesions, by diverticula, &c.

3. Volvulus, or the twisting of a portion of intestine on itself or its mesentery.

4. Intussusception, or the invagination of a portion of intestine into the lumen of the portion of intestine immediately below it.

5. The various forms of external hernia.

6. Congenital malformation in the intestine.

The conditions which commonly give rise to chronic intestinal obstruction are—

1. Impaction of fæces, the result of habitual or accidental constipation.

2. Changes in the walls of the intestines themselves, consequent upon inflammation, ulceration, or the growth of cancerous or other tumours. (Under this head are included the various forms of stricture of the rectum.)

3. Pressure upon the intestine by tumours external to it.

4. Various forms of chronic peritonitis.

5. Contraction following injuries of, or operations upon, the intestines.

Although the conditions productive of intestinal obstruction have been divided into the acute and chronic, "it must not be taken as a fact in every case," says Mr. Pollock, whose classification of the causes of intestinal obstruction is similar to the above, "that acute symptoms cannot or do not depend on any one of the latter causes of obstruction; or a more chronic state of symptoms on any of the conditions noted in the first division; but as a general rule, we may venture with some degree of assurance to assert, that the several symptoms which will mark the cases coming under the first division are urgent, acute, and rapidly result in collapse and death, if not relieved by nature or art; while the greater number comprised in the second division are attended by symptoms which come on by degrees, may last many days, often weeks, or even months in some cases; are generally by so much the less urgent than the former in character, and permit of delay in treatment as regards surgical interference; allow time for consultation; are often capable of medical relief; and if surgical treatment be considered requisite, offer many more features favourable towards the prolongation of life, than do the acute cases of obstruction." Moreover, it must be remembered that cases of gradual contraction of the intestine, consequent upon the conditions here denominated "chronic," may often terminate suddenly in complete obstruction, and acute and alarming symptoms supervene.

Whether the obstruction be acute or chronic, the intestine above becomes sooner or later enormously distended with fæcal matter and flatus, and if the obstruction be not removed the case will

terminate fatally from exhaustion, peritonitis, or rupture of the intestine followed by collapse or peritonitis.

A. The conditions commonly productive of acute intestinal obstruction.

1. IMPACTION OF FOREIGN BODIES IN THE INTESTINES.

Gall-stones.

XVI. 84.—Portion of an ileum, the cavity of which is distended by an oval biliary calculus. The peritoneal coat of the distended part of the intestine is burst; the other coats are thin and tense.

The calculus here shown had passed through a large ulcerated opening from the gall-bladder into the ileum.

2. INTERNAL STRANGULATION.

Strangulation of a loop of intestine in a hole in the Omentum.

XVII. 99.—Portion of mesentery having in it a circular opening with dense, resisting, fibrous margins. Through this opening there passes a portion of small intestine, from the strangulation of which at the ring in question gangrene of the intestine and subsequent peritonitis proved fatal to the patient.

From a woman aged fifty-six.

XVII. 93.—Coils of small intestine. One of these having slipped through an aperture in the omentum, the gut has been constricted and strangulated by the margins of the opening. In the upper part of the preparation the intestine retains its natural appearance; in the lower it is of a dark, in the recent condition almost black, colour, its walls thickened and œdematous, in fact bordering upon a state of gangrene. Over portions of the serous surface lymph has been effused, and may be seen smeared over the outer wall, most abundantly about the seat of stricture.

The man from whose body these parts were removed was straining violently when he fancied that something gave way within the abdomen. Suddenly local pain ensued, rapidly becoming intense, and then general peritonitis. On the fourth day he was brought into the hospital. A few days after his admission he sank and died.

Strangulation of a loop of intestine by a band of adhesion.

XVII. 19.—Portion of the small intestines of a child strangulated by a band of adhesion, which is connected at both its extremities with the mesentery. Bristles are passed behind the band. The whole of the intestine below the constriction is strangulated, and its vessels are greatly congested. The mesenteric glands are swollen.

The child was seven years old. The obstruction had probably existed fourteen days before death.

XVII. 20.—Portion of small intestine, exhibiting a contraction caused by a part of the omentum, which, it appears, had become adherent to the wall of the intestine, had been drawn out into a firm cord, and, then, had been stretched across the adjacent portion of the canal.

XVII. 79.—Portion of a small intestine, with a part of the great omentum. The omentum is adherent to a fold of the intestine, and has become twisted around it so as to produce complete strangulation. The other end of the omentum was adherent to the femoral ring.

The patient, a middle-aged woman, had no discharge from the bowels for the last seven days of her life.

Strangulation of a loop of intestine by a diverticulum.

The diverticula, which are observed stretching from the ileum to the umbilicus, are generally supposed to be the unobliterated remains of the vitelline duct.

XVII. 92.—A diverticulum, arising from the ileum at about fifteen inches from its termination in the cæcum, and attached at its blind extremity by a ligamentous cord to the umbilicus. The portion of the ileum between the origin of this appendage and the cæcum had become twisted and entangled about it, causing strangulation which terminated fatally in thirty-six hours.

From a boy aged twelve years.

XVII. 94.—A diverticulum from the small intestine, to the free extremity of which a fibrous cord is attached; the other end of the cord is adherent to the mesentery. Through the loop thus formed a considerable portion of small intestine has slipped and become strangulated.

XVII. 53.—Portion of a small intestine from which a diverticulum is continued. The extremity of the diverticulum is adherent to the contiguous part of the mesentery, so as to form a circular aperture or ring. Through this aperture a portion of intestine twelve inches long passed, and became strangulated. The patient, a lad subject to constipation, died four days after the commencement of the signs of strangulation of the intestine.

3. VOLVULUS, OR THE TWISTING OF A PORTION OF INTESTINE UPON ITSELF OR ITS MESENTERY.

There is no specimen of volvulus in the Museum.

4. INTUSSUSCEPTION.

By intussusception is meant the invagination of a portion of intestine into the lumen of the intestine immediately below, so that the appearance presented is that of three tubes, one within the other. To facilitate comprehension Rokitansky has called the outer tube the sheath, the innermost the entering tube, and the

middle one the receding or inverted tube; the last two together form the intussuscepted portion. It follows, therefore, that there are two peritoneal and two mucous surfaces of intestine in contact with each other, *i. e.* the contiguous surfaces of the outer and middle tubes are mucous membrane, and the contiguous surfaces of the middle and inner peritoneum. Between the inner and middle tubes is necessarily found a portion of mesentery or meso-colon, the dragging of which causes the intussuscepted portion to assume a greater curvature than its sheath, and its orifice to be directed towards the mesenteric attachment. This constant traction causes the puckering seen along the concavity of the intussuscepted portion, and its slit-like instead of circular aperture.

The intussusception increases at the expense of the lower portion of the intestine, the sheath becoming more and more infolded, so that should the invagination occur at the lower part of the ileum, no more of the ileum above the intussusception will be involved, but the cæcum and the colon below.

If the intussusception is not relieved the blood-vessels of the involved mesentery become constricted where the latter enters into the sheath, causing obstruction to the circulation in the receding tube, the mucous and peritoneal surfaces of which consequently become intensely congested and inflamed, giving rise to great swelling and tumefaction and to the sanious discharge from the mucous surface so diagnostic of the disease. The sheath and the entering tube are at first but little affected; as the tumefaction, however, of the receding tube, increases, the intussuscepted portion becomes tightly constricted at its entrance into the sheath, and the contiguous peritoneal surfaces become united by adhesive inflammation. Should the peritonitis thus set up remain localized the strangulated portion may slough at the constricted spot and be passed per anum, and the patient recover. Stricture of the intestine is, however, apt to occur subsequently at the spot where the portions of intestine have become united.

The amount of intestine which may be intussuscepted varies from a few inches to many feet. Intussusception may occur in any part of the intestine; the parts most liable to it, however, are the lower portion of the ileum and the large intestine. It is rare in adults, but common in children, especially in infants.

XVII. 91.—Portion of ileum inverted into the cavity of the adjoining cæcum. The relations of the layers of the intestine implicated may be recognised by tracing the mucous membrane lining the cæcum, the ensheathing layer, which passes down over the inverted layer, and is thence continued upwards through the central canal and passes on to the upper portion of the ileum above the intussusception. Tracing

these layers from without we find first two mucous, then two serous, and, again, two mucous surfaces opposed to one another.

Between the serous layers is a band of mesentery carried down with the portion of ileum forming the entering tube, and to its tense condition is due the curved direction of the central canal. The inverted layer of mucous membrane is thickened, especially where it curves round to be continued up the central tube.

XVII. 60.—Intussusception of the small intestine of a child. The lower portion of the intestine is laid open, and the inverted upper portion is shown ensheathed in it.

XVII. 61.—Intussusception of a large portion of the ileum and of the appendix cæci, within the cæcum and ascending colon. There is also a diverticulum ilei which has passed into the colon with the intussuscepted ileum, but has become everted, and has passed back again into the ileum; thus producing a double intussusception, of the ileum within the colon, and of the diverticulum within the ileum. At the upper part of the preparation is the cæcum with the commencement of the intussusception and the inverted diverticulum ilei; at the lower part is the whole of the intussuscepted ileum, which was of a dark brown colour, its vessels being distended with blood.

The patient was a man thirty-six years old, who for six months before his death had often suffered pain in his abdomen. He died with peritonitis and obstruction of the intestine.

XVII. 62.—Intussusception, in which a considerable portion of the ileum with the cæcum and its appendix have been inverted into the lumen of the ascending colon.

XVII. 63.—Portion of small intestine, nearly three feet long, which was discharged in a gangrenous state from the anus.

XVII. 64.—The cæcum and a portion of ileum connected with it from the same person as the preceding specimen. The cæcum is opened to show the condition of its mucous membrane, which is extensively ulcerated, and portions of it which hang in shreds in the cavity of the intestine. A straw is passed from the cæcum through the ileo-cæcal valve. The ileum is opened to show the adhesion of its extremity to the cæcum, and the continuity of their mucous membrane.

The patient was a woman forty-eight years old, subject to constipation. Seventeen days before the discharge of the portion of intestine in No. 63 she was seized with signs of internal strangulation of the intestinal canal, which continued for six days, and then became less. Subsequent to the discharge of the intestine, which took place eleven days after the partial cessation of the intestinal obstruction, the patient had fecal evacuations, but she died exhausted ten days after the discharge.

It is probable that there had been an intussusception of the ileum into the cæcum and colon; and that the ensheathed portion had sloughed off after it had become adherent at the point of inversion to the portion in which it was ensheathed.

XVII. 67.—Intussusception. The cæcum and right lumbar portion of the colon are inverted and protruded into the arch of the colon,

which is laid open to show the intussuscepted intestine projecting into its cavity. A piece of glass is introduced into the orifice of the intussuscepted intestine, which in some degree retains the dark colour it presented in the recent state. From a child two years old, who died after a few days' illness in consequence of obstruction in the alimentary canal.

XVII. 72.—Intussusception from a child. The cæcum and a portion of the ileum are inverted and protruded into the colon. Inflammatory material is deposited on the protruded portion of the intestine, the effect of its inflammation. The intussusception was fatal by its obstruction to the passage of the intestinal contents.

XVII. 95.—Large intestine of a boy aged three and a half years. The cæcum, ascending and part of the transverse colon are invaginated into the lower half of the large intestine, so that during life the inverted cæcum and appendix protruded two and a half inches through the anus. The external aperture is transverse, and situated at the middle of the anterior aspect of the protruded portion, which is formed by the lower end of the ileum at its junction with the cæcum.

The child had suffered for eight months with alternate diarrhoea and constipation. The prolapsus of the bowel was first noticed four months before death.

5. EXTERNAL HERNIA.

For obstruction consequent upon the various forms of external hernia, see "Hernia."

6. CONGENITAL MALFORMATIONS.

There are no specimens of obstruction from congenital malformations of the intestine in the Museum other than those of congenital deficiency of the rectum and of imperforate anus. See "Diseases of the Rectum."

B. *The conditions commonly productive of chronic intestinal obstruction.*

1. IMPACTION OF FÆCES.

There is no specimen of obstruction consequent upon the impaction of fæces in the Museum.

2. ALTERATIONS IN THE WALLS OF THE INTESTINES THEMSELVES CONSEQUENT UPON INFLAMMATION, ULCERATION, OR THE GROWTH OF CANCEROUS OR OTHER TUMOURS.

Contraction consequent upon the healing of an ulcer.

XVI. 7.—Portion of a jejunum and two portions of ileum. In both portions of intestine there is a circular constriction by which the

canal is completely closed. At each of the constricted parts a deep irregular ulcer extends in a narrow band around the whole circumference of the mucous membrane.

Obstruction consequent upon cancer of the intestines.

XVI. 120.—An ileo-cæcal valve, with parts of the cæcum and ascending colon. The several tissues forming the valve appear thickened and indurated with morbid deposit, which, in the recent state, had the characters of colloid cancer. The surface of the mucous membrane is roughly ulcerated. Similar disease, in less degree, exists in the immediately adjacent walls of the cæcum and colon. The aperture of the valve is an oval opening about one quarter of an inch in diameter, apparently fixed in both size and form.

XVI. 127.—Portion of the sigmoid flexure dilated, but not materially hypertrophied, above an annular stricture of the intestinal canal. Below this stricture is a crop of exuberant granulations, springing up from an irregular, warty, ulcerated surface. At the point of stricture the walls are thickened and infiltrated with a cancerous deposit, upon which has grown the soft medullary mass seen below. A bougie is passed through the narrow portion of the canal.

XVI. 135.—Part of the sigmoid flexure of the colon laid open. A soft, villous, malignant growth springing from the mucous membrane surrounds and almost obliterates the canal. From the body of a woman, aged forty-nine, who, having had for a few weeks occasional abdominal pain and constipation, which at length amounted to nearly complete obstruction, was suddenly attacked with extreme abdominal pain and with faintness, and died in a state of collapse in about three hours. On dissection it was found that the transverse colon had been drawn down in the shape of a V by a piece of omentum that was adherent in the sac of an old left femoral hernia. The colon thus displaced had, on the occurrence of obstruction at the sigmoid flexure, become enormously distended and then inflamed, and at length the softened coats had given way by a large thin-edged ulcer, through which fæcal matter had freely escaped into the peritoneal cavity.

Obstruction consequent upon the growth of fibrous tumours in the ileum.

XVI. 133.—Fibrous tumours in the ileum, causing partial obstruction of the bowel and a pouch-like dilatation above. From a woman, aged forty-three, who died from pyæmia.

Obstruction from stricture of the rectum, which is included under this head, will be found treated of under "Diseases of the Rectum."

3. PRESSURE UPON THE INTESTINE BY A TUMOUR EXTERNAL TO IT.

By an aneurism. XIII. 192.—A large false aneurism of the abdominal aorta. The aneurism by pressure had produced well-marked symptoms of constipation for about four months, which terminated in complete intestinal obstruction lasting for ten days.

4. VARIOUS FORMS OF CHRONIC PERITONITIS; AND 5, CONTRACTIONS FOLLOWING INJURIES OF, OR OPERATIONS UPON, THE INTESTINE.

The above causes of intestinal obstruction are not illustrated by specimens in the Museum.

HERNIA.

Hernia, or, more correctly speaking, abdominal hernia, is the protrusion of any of the contents of the abdomen or pelvis partially or completely through the abdominal or pelvic walls.

ANATOMY OF HERNIA.

A hernia consists of a sac and its contents.

I. THE SAC.

Two kinds of sac are described—the *acquired* and the *congenital*. The acquired sac consists of a pouch of peritoneum which the intestine or other viscus protrudes before it in its escape from the abdominal or pelvic cavity. The “congenital sac” consists of the “vaginal process of the peritoneum,” a tubular prolongation of the peritoneum, which is protruded in front of the testicle as the latter descends into the scrotum, and into which, when unobliterated, the intestine or other viscus may escape.

In the female a similar pouch of peritoneum (the canal of Nuck) is protruded in front of the round ligament, and may also become the sac of a hernia.

The sac consists of a body and neck.

The body is the expanded part of the sac; it is generally globular or pear-shaped, and varies greatly in size. It is at first thin-walled and transparent, but may afterwards become thickened and laminated. In some old cases of umbilical hernia, however, it becomes greatly thinned and even deficient in places.

The neck is the constricted part where the sac communicates with the peritoneal cavity. In a recent hernia it is thin and somewhat puckered, but after a time becomes smooth and thickened.

A. Usual appearance of the sac.

1. When recent.

There is no specimen of a quite recent sac in the museum, but see XVII. 22 and 29.

2. *When the hernia has existed some time.*

XVII. 8.—Congenital hernia from an adult, with general thickening of the sac.

XVII. 47.—The sac of an inguinal hernia slightly thickened and indurated.

B. *Unusual appearance of the sac.*

Bilocular form of sac.

XVII. 24.—Oblique inguinal hernia from a female. The sac has enlarged within the inguinal canal, and has thence extended through the opening in the aponeurosis of the external oblique muscle, so that it presents a bilocular form, part of the sac being lodged within the inguinal canal, part in the labium, and the two parts being in communication by a narrow neck, which lies within the external abdominal ring.

XVII. 6.—Inguinal hernia. The sac, which is of large size, is divided into an anterior and a posterior portion by a membranous partition, in the upper part of which there are several small apertures. A quill is passed from the mouth of the sac across its anterior portion, and through one of the apertures in the partition into the posterior portion. Except by these apertures, the posterior division of the sac has no communication with the anterior or with the cavity of the abdomen.

It is probable that that which is now the posterior division of the sac was at one time an ordinary hernial sac, the mouth of which was subsequently closed; that after this had occurred another sac was protruded in front of the former one; and that the apertures of communication between them were formed by the gradual thinning and absorption of their adjacent walls.

XVII. 37.—Very large congenital hernia. The sac is divided as if by a deep constriction from below upwards into two portions, which communicate by a large oval aperture at the upper part. The anterior division of the sac is the larger; the posterior has the testicle at its inner and back part.

XVII. 88.—The sac of an inguinal hernia, presenting, about an inch below its mouth, an annular contraction produced by thickening and induration of a narrow portion of the peritoneum.

It is probable that the thickened part of the sac had been its mouth, and had been enclosed within one of the abdominal rings, the pressure of which had produced the thickening; and that, by a larger protrusion of intestine, the mouth of the sac had been pushed outwards. The thickened part of the sac formed the stricture by which the intestine was strangulated.

Lobulation and partial deficiency of the sac.

A lobular condition and absence of portions of the sac in places is common in umbilical herniæ; in such cases the contents of the sac are in contact with the skin, and are liable to be wounded in operating

XVII. 33.—Part of a large umbilical hernia, the sac of which presents many irregular pouches, and appears in some parts deficient.

XVII. 46.—Section of an umbilical hernia, containing omentum. The omentum is firmly adherent to the sac, except in one situation where a part of the sac being deficient the omentum is in contact with the skin.

Inflammation of the sac.

See "Inflamed Hernia" (page 330).

Sloughing of the sac.

XVII. 25.—A femoral hernia, the sac of which has sloughed.

XVII. 58.—A similar specimen.

The sac combined with a hydrocele.

XVII. 3.—Inguinal hernia, combined with hydrocele of the tunica vaginalis testis, and a large membranous cyst, or encysted hydrocele, in the spermatic cord immediately above the testicle. The coverings of the hernial sac, which is situated above the hydroceles, are very thick.

XVII. 12.—Inguinal hernia, combined with hydrocele of the tunica vaginalis testis. The hernia is situated behind the enlarged tunica vaginalis, which is laid open anteriorly and is flattened by the pressure of the hernia. The neck of the hernial sac is also opened from the front and a portion of quill is introduced into it. The rest of the sac is opened posteriorly.

XVII. 15.—Inguinal hernia, combined with hydrocele of the tunica vaginalis testis. The hernial sac extends downwards to a short distance behind the upper part of the distended tunica vaginalis.

See also XVII. 39 and 50.

Two distinct sacs.

XVII. 57.—Inguinal hernia. There are two distinct hernial sacs side by side and closely united by their intermediate walls. Each sac has its separate orifice of communication with the abdomen, but the orifice of one is very small. The spermatic cord is behind both the hernial sacs.

The sac of a hernia is sometimes incomplete, as in those cases where the protruded viscus (*e. g.* the cæcum) is usually only in part covered with peritoneum; or there may be no sac at all, as in those cases where the protruded viscus has naturally no peritoneal covering.

Incomplete sac.

XVII. 76.—Inguinal hernia, in which the cæcum has protruded into the scrotum, carrying with it a partial peritoneal sac. The intestine is fixed to the outer side of the sac by its natural peritoneal connections.

Absence of sac.

No specimen.

II. THE CONTENTS OF THE SAC.

Although each of the abdominal or pelvic viscera has at one time or other formed the contents of a hernial sac, it is the intestine or omentum that most frequently constitutes this part of the hernia. When the sac contains intestine alone, the hernia is called an *enterocele*; when omentum alone, an *epiplocele*; and when both intestine and omentum, an *entero-epiplocele*.

The quantity of intestine forming an enterocele varies from a small knuckle to several feet, but when once a portion has descended there is a constant tendency for more to follow. The intestine is at first natural in appearance, but after a time it becomes thickened and narrowed, whilst the portion of mesentery which is drawn down with it becomes hypervascular and hypertrophied.

Any part of the small or large intestine may descend to form an enterocele, but generally it is a part of the ileum, or, in the case of the large intestine, generally the cæcum.

The omentum constituting an epiplocele also varies from a small to a very large quantity; and, as in the case of the intestine, when it has remained down for some time, it becomes thickened, hypertrophied, and matted together, and its veins assume a varicose condition.

In an entero-epiplocele the omentum descends first, and generally occupies the greater part of the sac, whilst the intestine that follows, generally consists merely of a small knuckle, and lies at the back of the sac, surrounded and hidden by the omentum.

The intestine has occasionally been found strangulated in consequence of the protrusion of a loop through an aperture in the omentum.

More rarely the intestine precedes the omentum, constituting the so-called epiplo-enterocele.

A. *Usual appearances of the contents of the sac.*

There are no good specimens illustrating the usual appearance of the contents of the sac. See, however, XVII. 21, 46, 28, and 55.

B. *Unusual appearances of the contents of the sac.**Thickening of the intestine.*

See XVII. 32.

Induration and thickening of the omentum.

XVII. 59.—A large portion of omentum, which was removed in the operation upon an inguinal hernia. It is in many parts thickened and indurated.

Apertures in the omentum.—XVII. 49.—A large portion of omentum, which was removed in an operation for strangulated inguinal hernia. Its tissue is generally indurated, and it exhibits numerous apertures bounded by blood-vessels, which form in some parts a kind of irregular network.

Protrusion of a knuckle of intestine through a hole in the omentum.

XVII. 65.—Inguinal hernia. A portion of omentum has become adherent to the inside of the sac in two situations, so as to form an aperture or ring, through which the intestine was protruded. A portion of glass is passed through the mouth of the sac and the ring formed by the omentum and the wall of the sac.

Adhesions between the contents of the sac and the sac-wall and between one another, and congestion, inflammation, and gangrene of the contents of the sac, are illustrated under "Irreducible Hernia" (page 323) and "Strangulated Hernia" (page 325).

c. Unusual contents of the sac.

The cæcum and part of the colon.

XVII. 12.—Inguinal hernia, combined with hydrocele of the tunica vaginalis. The contents of the sac were the cæcum and part of the colon.

The sigmoid flexure.

XVII. 32.—Large inguinal hernia. A portion of the sigmoid flexure of the colon, displaced from its natural situation by the dragging of the peritoneum into the hernial sac, is situated close by the mouth of the sac.

The sigmoid flexure, omentum, and portion of small intestine.

XVII. 41.—Femoral hernia, of unusually large size. The contents of the sac are omentum, with part of the sigmoid flexure of the colon and a portion of small intestine.

The ovary and Fallopian tube.

XVII. 78.—Part of the uterus, with the left inguinal canal and other adjacent parts, of a woman on whom an operation was performed for what was supposed to be a strangulated hernia. Below and in front of the inguinal canal, at the upper part of the left labium, a sac, like that of a large tunica vaginalis testis, and having no communication with the abdomen, is laid open. This sac was filled with fluid, and the left ovary and the extremity of the Fallopian tube are fixed to its posterior wall, with portions of the lining membrane of the sac reflected over them. A bristle is passed into the orifice of the Fallopian tube; the ovary is shrivelled.

The patient was a woman between thirty and forty years old. A fortnight after her delivery she had peritonitis, and gave such an account of the swelling produced by the sac in her groin, that it was supposed to be a hernia. The operation was performed, and she died three days afterwards.

The case may be regarded as one in which the ovary and Fallopian tube passed through the inguinal canal into the labium, in the same manner, and probably about the same time, as, in the male, the testicle and vas deferens pass into the scrotum; and in which, after such passage, the communication between the peritoneal pouch (carried with the ovary) and the general peritoneal cavity, was closed.

The gall-bladder.

XVII. 96.—The gall-bladder of a woman, aged forty-five. She was admitted into the hospital with a femoral hernia on the right side. The sac was opened and the contents were returned. She died of peritonitis some days after. On post-mortem examination the gall-bladder was found close to the ring, and a decided constriction was visible some little distance beyond the fundus. A portion of the groove on the inner side was ulcerated. The constriction and ulceration are still visible. The liver did not present the ordinary form; it was elongated from above downwards and drawn towards the ring. There was no evidence that any portion of the intestine or other structure, besides the gall-bladder, had passed through the femoral ring.

D. Effects of treatment upon the sac.

Obliteration of the neck of the sac by the pressure of a truss.

XVII. 9.—The remains of an inguinal hernia, after the closure and obliteration of the mouth of the sac. The peritoneum presents a puckered appearance and a funnel-shaped depression in the situation where the mouth of the sac formerly existed. The obliteration was the consequence of the long wearing of a truss.

XVII. 10.—A similar specimen, with the depression in the peritoneum on the abdominal aspect more strongly marked.

THE CONDITION OF A HERNIA.

A hernia may be reducible, irreducible, strangulated, incarcerated, or inflamed.

REDUCIBLE HERNIA.

A hernia is said to be reducible when the contents of the sac can be returned into the abdominal or pelvic cavity, leaving the sac empty. The sac itself, of course, cannot be put back into the abdomen, but remains in the position it occupied before the reduction of its contents.

IRREDUCIBLE HERNIA.

A hernia is said to be irreducible when the contents of the sac cannot be returned into the abdomen; this condition is owing to some impediment existing (1) outside the sac, (2) in the sac-walls, or (3) inside the sac.

1. *Impediments to reduction outside the sac.*

Impediment to reduction outside the sac consists in the constriction of the neck of the sac consequent upon (a) contraction, spasmodic or other, of the rings or other apertures through which the hernia has passed, or (b) the inflammatory condensation and contraction of the tissues around the neck.

Impediment consequent upon contraction of the rings, &c., will be illustrated under "Special forms of Hernia."

A specimen, exhibiting inflammatory thickening and contraction of the parts around the neck of the sac, follows.

XVII. 100.—The sac of an old inguinal hernia. The neck is surrounded by a very tough and firm ring of condensed fibrous tissue, which is prismatic in shape, being wide at its attachment and tapering to a very sharply defined and thin free margin. The diameter of the ring is only half an inch. Directly below this the sac dilates into a chamber, which, in the fresh state, was three inches across, and which rises into a pouch at its upper part that runs up behind and above the ring described.

2. *Impediment to reduction in the sac-walls.*

Under this head are placed inflammatory thickenings and contractions of the neck of the sac itself and inflammation of the sac.

These conditions of the neck of the sac are not illustrated in the Museum.

3. *Impediments to reduction inside the sac.*

The chief of these may be enumerated as:—The great bulk of the protruded intestine or omentum; the adhesion of the intestine or omentum to the walls of the sac or to each other; the adhesion of two coils of intestine or of two portions of omentum to each other; the collection of a large amount of fluid in the sac; the distension of the intestine with fæces or flatus; bands of adhesion stretching across the cavity of the sac or across its neck; the contraction of adhesions between the protruded intestine and the parts around, as when a portion of intestine not completely covered by peritoneum descends to form the hernia.

Adhesion of intestine to the sac-walls.

XVII. 13.—Inguinal hernia. A portion of small intestine has become extensively and firmly adherent to the walls of the sac.

Adhesion of omentum to the sac-walls.

XVII. 50.—The hernial sac is large; it communicated with the abdomen by a wide orifice, and there is a portion of omentum adherent to its lower part.

See also XVII. 65.

Adhesion of omentum to intestine.

XVII. 86.—A large portion of omentum, partially indurated, which was cut off in an operation for strangulated inguinal hernia. The narrow portion by which it is suspended was attached to a protruded piece of large intestine; the rest was unattached.

The patient, an elderly woman, recovered after the operation, so that it is impossible to say under what circumstances so large a portion of omentum had become connected with the large intestine alone, and with it by only a narrow pedicle.

Adhesion of coils of intestine to one another.

XVII. 39.—Several folds of intestine are firmly adherent to each other and to the hernial sac. The enlarged tunica vaginalis testis is situated in front of, and nearly envelopes, the sac of the hernia. Bristles are passed beneath the spermatic vessels, which are placed at some distance from each other behind the tunica vaginalis.

The adhesion of a portion of intestine only partly covered by peritoneum to parts around.

XIII. 76.—Inguinal hernia, in which the cæcum has protruded into the scrotum, carrying with it a part of the peritoneal sac. The cæcum is fixed to the outer side of the sac by its natural peritoneal connections.

STRANGULATED HERNIA.

A hernia is said to be strangulated when a portion of intestine or omentum is so tightly gripped, that not only is its return into the abdomen prevented, but its circulation is obstructed to such a degree that inflammation and gangrene speedily result if the constriction is not quickly relieved.

Causes of strangulation.

Strangulation may be induced by a sudden protrusion of a portion of intestine or omentum through a narrow aperture; or, in the case of an old hernia, by a sudden addition of a fresh portion of intestine or omentum to that already in the sac; or by swelling and congestion of the intestine, such as occur in functional disturbance of the alimentary canal; or by distension with fæces or flatus; or by the swelling and congestion of the mesentery or omentum, or of the neck of the sac; or by the slipping of a portion of intestine through an aperture in the omentum or mesentery; or by constriction caused by bands of adhesions stretching across the cavity of the sac.

Seat of the stricture.

The seat of the stricture in a strangulated hernia may be (1) outside the neck of the sac, (2) in the neck of the sac itself, or (3) within the sac.

The seat of the stricture when outside the neck of the sac is at one of the tendinous rings or other apertures through which the hernia has escaped, and will be further referred to under the head of "Various forms of Hernia."

Seat of the stricture in the neck of the sac itself.

XVII. 11.—Incomplete inguinal hernia, strangulated. The intestine is contained within the inguinal canal. The aponeurosis of the external oblique muscle is divided and turned upwards. The sac, containing the small portion of strangulated intestine, is opened from the front. The lower border of the internal oblique and transversalis muscles crosses over the neck of the sac. Two bristles are passed between the mouth of the sac, where the thickened peritoneum constitutes the stricture, and the strangulated intestine. Another bristle is passed beneath the epigastric vessels.

Seat of the stricture inside the sac.

When the seat of the stricture is inside the sac the strangulation may be due to the constriction of the intestine by bands of adhesion stretching across the cavity of the sac or the slipping of a loop of intestine through a hole in the mesentery or omentum, in which it may become tightly gripped in consequence of the swelling of the included intestine.

XVII. 2.—Inguinal hernia. A portion of small intestine was found just behind the external inguinal ring, strangulated by a band of adhesion, extending from the peritoneum near the ring to the mesentery. The testicle is situated within the upper opening of the inguinal canal.

XVII. 65.—Inguinal hernia. A portion of omentum has become adherent to the inside of the sac in two situations, so as to form an aperture or ring, through which the intestine was protruded.

Mechanism of strangulation.

When from one or more of the causes above enumerated a portion of intestine or omentum becomes constricted, the compression of the veins at the seat of stricture impedes the return of venous blood from the protruded part, which consequently becomes congested and ultimately passes into a gangrenous condition. The congestion also induces paralysis of the muscular coat and consequent cessation of the peristaltic action and onward flow of the intestinal contents.

For strangulation to occur it is not necessary, however, that the whole circumference of the bowel be included in the stricture; an inclusion of only a small portion of the circumference, in consequence of the venous congestion and subsequent inflammation which it induces, is sufficient to cause it.

Appearances of the strangulated intestine and omentum.

The first changes seen in the strangulated intestine are due to congestion caused by the partial arrest of the circulation. The intestine does not appear altered except that it is red and swelled, while a small amount of serous fluid is poured out between it and the sac. When the arrest of the circulation is complete the congestion becomes more intense, the intestine appears more swelled, dark purple, and mottled; it is no longer shining, and it feels sticky to the fingers. When the strangulation has lasted some time the congestion passes into gangrene, the intestine appears black or ashen-grey, doughy in consistence, and pits on pressure. The fluid in the sac, which was at first serous, is darker, turbid, and feculent in odour. Finally, the gangrenous intestine sloughs, and its fecal contents are extravasated into the sac. Sloughing or ulceration of the intestine frequently begins at the situation of the stricture, where the intestine at an early stage often exhibits the impression of the stricture upon its coat.

The changes in the strangulated omentum are similar to those which occur in the intestine. The omentum, at first red and injected, passes gradually into a state of gangrene, when it appears black or yellowish grey, the blood in its veins is coagulated, and it feels crisp and emphysematous to the touch.

XVII. 77.—Strangulated femoral hernia, upon which no operation was performed. The sac and its coverings are in great part removed. The portion of small intestine contained in the sac presents a black and mottled appearance, from the intense congestion of its vessels. The small calibre of the intestine below the strangulated part is strongly marked.

XII. 66.—Femoral hernia, with mortified intestine. The fascia superficialis is separated from the fascia propria, showing the smooth external surface of the latter. The fascia propria and subjacent fat are closely united to the hernial sac. The mortified intestine, of an ash-grey colour, and covered with inflammatory material, is in the centre of the sac. The upper and lower portions of intestine leading to the strangulated part are laid open; the upper portion is distinguishable by the thickness of its coats and the dilatation of its canal.

XVII. 42.—Portion of small intestine, from an inguinal hernia, exhibiting the impression of the stricture upon its coats.

XVII. 18.—Portion of small intestine, which was strangulated in a femoral hernia. Its coats have sloughed and given way at that part of its circumference which lies nearest to Gimbernat's ligament—a very common occurrence.

XVII. 80.—Portion of small intestine, which was strangulated in the sac of a femoral hernia. On one side it exhibits but a slight indentation from the stricture; on its other side, which corresponded with

Gimbernat's ligament, there is a large aperture in it, and its coats are very thin.

XVII. 43.—Portion of small intestine from a femoral hernia. Several openings have been formed in consequence of the sloughing of the part of the intestine which was enclosed in the stricture; and around these openings the coats of the intestine are very soft and readily separable.

XVII. 85.—A portion of jejunum, of which a part of the circumference was strangulated in one of the crural canals. The strangulated portion has been drawn out like a short diverticulum from the rest of the intestine, and has a wide ulcerated aperture through its coats at the part which was nearest to Gimbernat's ligament.

XVII. 89.—Section of a portion of small intestine, which was strangulated in a femoral hernia, to show the sharp-edged fold of mucous membrane which projects into the canal of the strangulated portion from the angle formed by the portions above and below it.

XVII. 44.—Portion of small intestine from a femoral hernia, exhibiting the effects of strangulation. The intestine has been opened. Near its upper border the impression of the stricture is marked by the thickening and partial ulceration of its coats. The lower portion of the intestine, which was strangulated, is distinguished by its dark colour and pulpy texture.

XVII. 17.—Portion of a jejunum, which was strangulated in an umbilical hernia. In the situation of the stricture the intestine is contracted, and immediately above it is a small, round, ulcerated aperture, into which a portion of glass is passed. Recent inflammatory formations are seen around these apertures on the mucous covering.

XVII. 16.—Portion of an ileum, which was strangulated in an umbilical hernia. In the situation of the stricture the intestine is considerably contracted, and its coats have sloughed and given way in the greater part of its circumference.

XVII. 98.—A portion of the small intestine of a man, aged sixty-nine, who was admitted with an umbilical hernia, which had been strangulated six days. In the operation it was found, from the escape of fluid fecal matter, that the intestines had given way. Across the portion of intestine preserved a constriction is seen, which corresponded with the tight margin of the umbilical aperture at its lowest part. A line of intestine at the constricted part had perished, and was of an ashen hue. In the centre of this is an aperture, through which, at the time of the operation, a slough, more than an inch long, escaped, which, no doubt, came from the mucous and muscular coat at the seat of stricture, for at that part the peritoneal coat alone remains.

Laceration of the coats.—XVII. 73.—Portion of small intestine, from a femoral hernia upon which an operation had been performed a few days before death. A considerable opening was found in the intestine, apparently from laceration of its coats, and its edges were drawn together by suture. Inflammatory matter formed upon the peritoneal and upon the mucous surface and round the opening, so that the latter is completely closed by it.

XVII. 86.—A large portion of omentum, which was cut off in an operation for inguinal hernia.

Condition of the intestine above and below the strangulated portion.

The intestine above the strangulated portion is distended with fæcal matter, and congested, the congestion gradually ceasing as the intestine is traced towards the stomach. The intestine below the strangulated portion appears empty and contracted, but not congested.

Result of strangulation when not relieved by taxis or operation.

When the strangulation is not relieved the intestine or omentum, as we have seen, becomes gangrenous and sloughs or ulcerates, and the fæcal contents of the intestine are extravasated into the sac. Extravasation of fæces into the general peritoneal cavity, however, does not occur, as the intestine internal to the stricture becomes glued to the parietal layer of the peritoneum by adhesive inflammation. The irritation caused by the extravasated fæces sets up inflammation of the sac, which extends to the surrounding tissues, and rapidly runs on to suppuration, and the fæcal abscess thus formed ultimately opens upon the surface. The inflammation, moreover, generally spreads to the peritoneal cavity, and the patient dies of local or general peritonitis.

XVII. 58.—Femoral hernia, in the male. The hernial sac and its contents have sloughed; their remains are a pulpy mass, in which no distinction of parts can be recognized. Three portions of small intestine were protruded into the hernial sac. A portion of straw is passed into each of their orifices.

Accidents liable to occur during attempts at reduction (Reduction en masse—Rupture of the sac).

During attempts at reduction of an inguinal hernia, either by the patient or surgeon, if too much force is used, the sac, as well as its contents, may be pushed back into the upper part of the inguinal canal or into the abdominal cavity, *i. e.* between the parietal layer of peritoneum and fascia transversalis (*réduction en masse*), the strangulation in either case remaining unrelieved. Or in other instances, as pointed out by Mr. Birkett, the posterior wall of the sac may be ruptured and the intestine forced through the rent into the subserous connective tissue behind the sac, the intestine, as in the former cases, being still constricted by the neck of the sac. This latter accident is said by Mr. Birkett to occur most frequently in the congenital form of inguinal hernia. Although

"réduction en masse" is most frequent in cases of inguinal hernia, it sometimes happens in femoral hernia, a good instance of which is related by Mr. Bryant.

XVII. 56.—Congenital hernia, for the reduction of which the operation was performed. At the front of the preparation is a portion of the hernial sac, which extended from the inguinal ring into the scrotum, and within which some small intestine and the testicle are seen. At the back is another portion of the sac, which was found after death pushed back and inverted into the abdomen.

It is probable that before the operation a portion of the hernial sac had been pushed backwards into the abdomen, and that in the operation the strangulated intestine was pushed from the lower part of the hernial sac, which still remained external to the abdomen, into that part of it which was still within the abdomen.

XVII. 68.—Inguinal hernia, for the reduction of which an operation was performed a short time before death. On one side of the preparation there is a portion of the spermatic cord, and a little above it is an opening which, in the operation, was made into the inguinal canal. On the other side of the preparation is the hernial sac, extending downwards into the pelvis by the side of the urinary bladder, to which it was attached. In the upper part of this sac is a circular orifice; this was the mouth of the sac through which the intestine passed from the cavity into the abdomen. The outer and larger opening in the sac was made in the examination of the parts after death.

It is probable that the hernial sac, which now appears extending downwards into the pelvis, had originally been situated in the scrotum, and that in the efforts to reduce the hernia, previous to the operation, both the contents and the sac had been pushed into the cavity of the abdomen. The intestine in the sac was found mortified from the tightness of the stricture, which was formed entirely by the peritoneum at the mouth of the sac; and it will be observed that by the displacement of the sac its mouth had become situated deep in the abdomen, at a great distance from the internal abdominal ring.

INFLAMED HERNIA.

Irreducible herniæ, exposed as they necessarily are to injury, are liable to become inflamed, and are then generally spoken of as inflamed herniæ. The sac appears red, congested, swollen, and covered on its internal surface with inflammatory exudation. The contents of the sac are not materially affected. If the inflammation is long continued the sac becomes indurated, thickened, and consolidated with the surrounding parts.

XVII. 28.—Femoral hernia. The coverings of the sac are displayed by the separation of the fascia superficialis and fascia propria. Within the latter the sac itself is shown, covered with inflammatory material on its internal surface. The mouth of the sac is about a quarter of an

inch in diameter. The epigastric vessels are situated three quarters of an inch from the outer border of the mouth of the sac.

XVII. 35.—Oblique inguinal hernia. The sac and its coverings are thickened, indurated, and consolidated by inflammation; and its internal surface is made rough by the deposit of inflammatory products upon it.

INCARCERATED HERNIA.

A hernia is said to be incarcerated when the protruded portion of intestine becomes obstructed by hardened fæces, foreign bodies, flatus, &c. Such a condition is most commonly met with in irreducible herniæ in old people. There is no specimen of it in the Museum.

SPECIAL FORMS OF HERNIA.

INGUINAL HERNIA.

An inguinal hernia is one which escapes into or through the inguinal canal. There are two chief varieties, the oblique or external, and the direct or internal.

OBLIQUE OR EXTERNAL INGUINAL HERNIA.

The oblique or external inguinal hernia is so called because it escapes *obliquely*, leaving the abdomen by the internal abdominal ring, *externally* to the deep epigastric artery. When the hernia stops in the canal it is called incomplete, or from its resemblance to a bubo, a bubonocoele; when it passes completely through the canal and protrudes at the external ring, it is said to be complete, and is sometimes called a scrotal or a labial rupture, according as it descends into the scrotum or labium. Whilst traversing the inguinal canal the direction of the hernia is downwards, inwards, and forwards, but on emerging from the canal it passes downwards, inwards, and a little backwards.

The coverings of an oblique inguinal hernia.

The coverings of an oblique inguinal hernia vary slightly according as the hernia is complete or incomplete, and according as it occurs in the male or female.

1. *Coverings of a complete oblique inguinal hernia.* A. *In the male*—The coverings of a complete oblique inguinal hernia in the male are seven. 1. Skin. 2. Superficial and deep fascia. 3. Intercolumnar fascia. 4. Cremasteric fascia. 5. Infundibuliform fascia. 6. Sub-peritoneal fat; and 7. Peritoneum, which constitutes the sac.

B. *In the female.*—In the female the cremasteric fascia is wanting, otherwise the coverings are the same as in the male.

XVII. 4.—Complete oblique inguinal hernia, the sac of which has just passed through the external abdominal ring; its cavity is laid open from the side, and its several coverings are displayed. A bristle is passed beneath the epigastric artery, where it passes on the inner margin of the internal ring, showing that the neck of the sac is external.

2. *Coverings of an incomplete oblique inguinal hernia—male or female.*—The coverings of an incomplete oblique inguinal hernia are the same in both male and female. They are: 1. Skin. 2. Superficial and deep fascia. 3. Aponeurosis of the external oblique (instead of the intercolumnar fascia, as in the complete). 4. Lowermost fibres of the internal oblique and transversalis muscles. 5. Infundibuliform fascia. 6. Subperitoneal fat. 7. Peritoneum.

XVII. 5. Incomplete oblique inguinal hernia. Portions of the aponeurosis of the external oblique, and of the lower border of the internal oblique and transversalis muscles, are raised from their connections, to show the passage of the hernial sac through the internal inguinal ring. The coverings of the sac are displayed, and its cavity is opened.

XVII. 11.—Incomplete oblique inguinal hernia. The intestine is contained within the inguinal canal, the aponeurosis of the external oblique muscle is divided and turned upwards. The sac containing a small portion of strangulated intestine is opened from the front. The lower border of the internal oblique and transversalis muscles crosses over the neck of the sac. A bristle is passed under the epigastric vessels.

Varieties of oblique inguinal hernia.

Several varieties of oblique inguinal hernia have been described, of which the following are the chief:—1. The common form (or the inguino-scrotal of Birkett). 2. The congenital (or hernia into the vaginal process of the peritoneum of Birkett). 3. The infantile (or hernia into the funicular portion of the vaginal process of the peritoneum of Birkett). 4. The encysted congenital.

1. The common or acquired form.

In this variety the sac consists simply of a protrusion of peritoneum into or through the inguinal canal, and when complete may extend into the scrotum or labium, according as it occurs in the male or female. The testicle can always be felt either below or in rare instances behind the hernia.

XVII. 4.—Oblique inguinal hernia, the sac of which has just passed through the opening in the aponeurosis of the external oblique muscle.

XVII. 24.—Oblique inguinal hernia, from a female. The sac has enlarged within the inguinal canal, and has thence extended through the opening in the aponeurosis of the external oblique muscle, so that it presents a bilocular form, part of the sac being lodged within the inguinal canal, part in the labium, and the two parts being in communication by a narrow canal, which lies within the external abdominal ring. The aponeurosis of the external oblique is reflected from the part of the sac which is in the inguinal canal, the neck of which part is crossed by the internal oblique and transversalis muscles.

Cast from the subject of this hernia, No. 4.

2. *The congenital, or hernia into the vaginal process of peritoneum.*

In this variety the intestine descends into the vaginal process of the peritoneum, which is protruded in front of the testicle in the descent of that organ into the scrotum. Several varieties of congenital hernia are described, for an account of which the student is referred to the larger works on surgery. In the common variety the testicle is found in its normal situation in the scrotum, and is generally surrounded by and in contact with the hernia, but the testicle may be found in the abdomen, in the inguinal canal, or just external to the external abdominal ring, in which cases the hernia will be incomplete.

In the female a similar congenital oblique inguinal hernia may occur, the intestine descending into a pouch-like prolongation of peritoneum, in front of the round ligament of the uterus (the canal of Nuck).

XVII. 7.—Congenital hernia, from an adult. The roll of paper is passed through the inguinal canal into the cavity of the tunica vaginalis testis, in the place formerly occupied by the protruded intestine.

XVII. 8.—A similar specimen.

XVII. 81.—Large congenital hernia. In consequence of the yielding of the tunica vaginalis at its lower part, the testicle is situated in the centre of the posterior wall of the sac.

XVII. 38.—Congenital hernia, from an adult, for the removal of which an operation was performed. The testicle and the hernial sac are situated within the inguinal canal.

XVI. 1.—Congenital inguinal hernia. The testicle has not passed through the inguinal ring; it was found within the canal, and is connected with the upper part of the hernial sac. It is smaller than natural, but its structure is healthy. The lower part of the epididymis is removed from the body of the testicle and passes down the posterior part of the hernial sac. The vas deferens also passes along the same part, and becoming small and very tortuous reaches nearly as far as the end of the epididymis just described.

XVII. 37.—A very large congenital hernia. The sac is divided, as if by a deep constriction from below upwards, into two portions, which communicate by a large oval aperture at the upper part. The anterior division of the sac is the larger; the posterior has the testicle at its inner and back part.

3. *The infantile.*

In this variety the intestine, enclosed in its sac, descends behind the funicular portion of the tunica vaginalis which has not been obliterated, so that when an operation is necessary three layers of peritoneum have to be cut through, viz. the anterior layer of the unobliterated funicular portion of the tunica vaginalis, the posterior layer of the same, and finally the true sac.

There is no specimen in the Museum.

4. *The encysted congenital.*

In this variety the sac of the tunica vaginalis is separated from the general peritoneal cavity by adhesions. These adhesions yield to the pressure of some portion of intestine, and become elongated and invaginated before it into the still unobliterated portion of the tunica vaginalis. In this case, should an operation be necessary, the anterior layer of the tunica vaginalis and the spurious sac formed by the elongated adhesions would have to be cut through before the intestine could be exposed.

Relation of the cord to the sac in oblique inguinal hernia.

In recent cases the spermatic cord is situated *behind* the sac, but in old-standing cases its constituents may become separated and spread over the body of the sac.

XVII. 29.—Two inguinal hernia, one direct, the other oblique. On the right side the hernia is oblique, and has descended into the scrotum. The spermatic cord is behind the sac.

XVII. 14. Oblique inguinal hernia, exhibiting the separation and displacement of the vessels of the spermatic cord in consequence of its pressure. The spermatic artery and the vas deferens are situated close together on the inner and posterior part of sac; the spermatic veins are nearly an inch distant from them. Large fasciculi of the cremaster muscle are interlaced over the front of the hernial sac.

Relative position of the rings in oblique inguinal hernia of long standing.

XVII. 71.—Oblique inguinal hernia, dissected to show the change in the relative position of the external and internal inguinal rings, in consequence of oblique hernia of long standing. In the front of the preparation the aponeurosis of the external oblique and the external ring are shown; at the back, the pubic portion of the fascia transversalis, with its edge forming the internal boundary of the inner ring

which edge lies directly behind the middle of the opening of the external ring.

Seat of the stricture.

The stricture when external to the sac may be at the external ring, at the internal ring, or at any part of the inguinal canal. (Stricture within the sac, or in the neck of the sac itself, has already been illustrated under the head of the "Anatomy of Hernia," and will not further be referred to while discussing the seat of stricture in the special forms.)

Relation of the epigastric artery to neck of the sac.

The epigastric artery, in oblique inguinal hernia, is internal to the neck of the sac.

XVII. 4.—Oblique inguinal hernia: a bristle is passed beneath the epigastric artery, where it passes on the inner margin of the internal ring, *i. e.* internal to the neck of the sac. See also XVII. 29.

XVII. 45.—Oblique inguinal hernia, showing the injected epigastric passing round the inner side of the neck of the sac.

DIRECT OR INTERNAL INGUINAL HERNIA.

The direct or internal inguinal hernia is so called because it escapes directly through the external abdominal ring (without passing through the internal ring and inguinal canal) internal to the epigastric artery.

Coverings of a direct or internal inguinal hernia.

The coverings from without inwards are:—1, skin; 2, superficial and deep fascia; 3, intercolumnar fascia; 4, fascia transversalis; 5, sub-peritoneal fat; and 6, peritoneum, which forms the sac. Sometimes the conjoined tendon forms one of the coverings; usually, however, the hernia passes through that structure, or under or over it.

It will be thus seen that the coverings of a direct hernia differ from those of an oblique in the absence in the former of the cremasteric fascia and the substitution of the fascia transversalis for the infundibuliform fascia.

XVII. 30.—Direct inguinal hernia, incompletely protruded through the external inguinal ring. The fascia transversalis is protruded before it; and immediately below the mouth of the sac, the peritoneum lining the abdominal muscles is dilated into a wide pouch.

XVII. 3.—Direct inguinal hernia, combined with hydrocele of the

tunica vaginalis testis, and a large membranous cyst or encysted hydrocele in the spermatic cord immediately above the testicle. The coverings of the hernial sac, which is situated above the hydrocele, are very thick.

Relation of the cord to the sac in direct inguinal hernia.

In internal or direct hernia the spermatic cord along with the cremaster muscle lies external to the sac.

XVII. 30.—Direct inguinal hernia. The spermatic cord is on the outer side of the sac.

Seat of stricture.

The stricture may be situated at the external abdominal ring, or at the aperture in the conjoined tendon through which the hernia has passed.

Relation of the epigastric artery to the neck of the sac.

XVII. 29.—Two inguinal herniæ, one direct, the other oblique. On the right side, the hernia is oblique, and has descended into the scrotum. The epigastric artery is close to the inner margin of the mouth of its sac, and the spermatic cord is behind the sac. On the left side, the hernia is direct, having passed from the abdomen directly through the external inguinal ring. The epigastric artery is near the *outer margin* of the mouth of its sac; and the spermatic cord is between the sac and the outer column of the external ring. The sac of this hernia is withdrawn from the covering of the fascia transversalis, which was protruded before it, and is inverted towards the abdominal cavity.

FEMORAL HERNIA.

Hernia is called femoral when it escapes through the femoral ring. It first takes a direction downwards, through the femoral ring, into the femoral canal, and arriving at the saphenous opening passes forwards through that aperture and then upwards and outwards on to the aponeurosis of the external oblique muscle.

XVII. 48.—Femoral hernia, in a male, dissected so as to show the peculiar form of the tumour.

Coverings of a femoral hernia.

The coverings of a femoral hernia from without inwards are:—1, skin; 2, superficial fascia; 3, cribriform fascia; 4, fascia propria (*i. e.* the anterior wall of the femoral sheath); 5, subperitoneal fat; 6, peritoneum, which constitutes the sac.

XVII. 22.—Femoral hernia, of recent occurrence. On the front of the preparation the fascia propria is shown, laid open from the front,

and crossed above by the semilunar edge of the fascia lata. At the back, the hernial sac is separated from the fascia propria, withdrawn from beneath the crural arch, and inverted towards the abdominal cavity.

XVII. 26.—Femoral hernia, for the reduction of which the operation was performed. The coverings of the sac are displayed. The fascia superficialis is separated from the fascia propria. The fascia propria is also raised; it is thick, and its internal surface is cellular. Within the fascia propria the remains of the sac are shown.

Seat of stricture.

The stricture may be at the superior cornu of the saphenous opening (Hey's ligament), at Gimbernat's ligament, or at the deep crural arch.

XVII. 25.—Femoral hernia, for the reduction of which the operation was performed. The sac has sloughed; its remains are soft and black. The incision of the stricture has been carried from the anterior part of the sac directly upwards.

XVII. 27.—Femoral hernia, for the reduction of which the operation was performed. The sac is collapsed and thickened. The incision of the stricture has been carried from the anterior part of the sac upwards and inwards.

Relations of the neck of the sac.

The neck of the sac is situated at the femoral ring, and has therefore, in the supine position of the body, Poupart's ligament and, at some short distance, the spermatic cord above it, Gimbernat's ligament on its inner side, the femoral vein on its outer side, and the bone below it.

Relation of arteries to the neck of the sac.

There are usually no arteries of consequence in immediate relationship with the neck of the sac. When, however, as frequently happens, the anastomosis between the pubic branch of the epigastric and the pubic branch of the obturator becomes enlarged, or when the obturator artery itself is given off directly from the epigastric, a large artery will be found winding round either the outer or the inner side of the neck of the sac. In the latter situation the artery is very liable to be wounded should an operation be performed, as the incision for the division of the stricture in femoral hernia is usually made either directly inwards or obliquely upwards and inwards.

XVII. 55.—Two femoral herniæ, in the male, exhibiting different relations of the obturator artery to the mouth of the hernial sac. Both

the obturator arteries arise by common trunks with the epigastric arteries. On the right side, the obturator artery descends to the obturator foramen close to the outer margin of the mouth of the sac. On the left side, the obturator artery in its course to the obturator foramen turns round the inner border of the mouth of the sac. On the right side, the common trunk of the two arteries is about a quarter of an inch long; on the left, it is about three quarters of an inch long.

XVII. 69.—Portion of a male pelvis, with parts of the abdominal muscles, exhibiting the sacs of two femoral herniæ. On each side the obturator artery, arising with the epigastric by a common trunk, about half an inch long, turns round the inner border of the sac; while the obturator vein, arising separately from the epigastric, passes round the outer border.

Unusual forms of femoral hernia.

Several rare forms of femoral hernia have been described. Of these the "femoral hernia through Gimbernat's ligament" (or "the hernia of Laugier," as it is sometimes called after Laugier, who was the first to describe it) alone is represented in the Museum.

XVII. 52.—Femoral hernia. A small peritoneal sac has been protruded between the fibres of Gimbernat's ligament. A bristle is passed beneath the portion of the ligament which intervenes between this peritoneal sac and the space through which the femoral hernia usually passes.

The author is not aware that the variety seen in the following specimen has been described:

XVII. 75.—Femoral hernia. In the peritoneum covering the femoral ring there are the orifices of two distinct hernial sacs close together. The outermost of these sacs extends beneath the semilunar edge of the fascia lata, and over the femoral vessels. The inner sac is so small that it does not protrude behind Poupart's ligament.

UMBILICAL HERNIA.

An umbilical hernia is one that escapes through the umbilical ring, or through an aperture in the linea alba in the neighbourhood of the umbilicus.

The sac always consists, according to Mr. Birkett, of a protrusion of the parietal layer of the peritoneum, and never, as is sometimes stated, of a natural protrusion of the peritoneum, through the umbilical ring.

"In infants the protruding viscus pushes before it that portion of the parietal peritoneum lying immediately behind the aperture through which the umbilical vessels enter the abdominal cavity. The hernial sac is thus formed before the closure of the

ring is effected, and may pass into the connective tissue of the cord itself before that structure has separated." In youth the hernia dilates the partially closed ring and so escapes. In adults it passes between the fibres of the linea alba in the neighbourhood of the umbilicus (Birkett). An umbilical hernia is generally of large size, and of a somewhat globular or irregularly lobulated shape, and nearly always extends in a direction downwards towards the pubes.

The sac is generally very thin and attenuated, often lobulated and frequently cribriform, or altogether deficient in places. The contents of the sac usually consist of omentum and of a small knuckle of intestine, which often lies concealed by the omentum near the neck of the sac.

Series A. 184.—A congenital umbilical hernia. The lower end of the ileum, the cæcum, and the ascending colon, are protruded through the umbilicus, and were contained in a cavity bounded by the extended substance of the umbilical cord.

XVII. 34.—Portion of the abdominal muscles, exhibiting a large circular opening in the linea alba through which an umbilical hernia was protruded.

XVII. 82.—Portion of the anterior wall of an abdomen, exhibiting a large umbilical hernia. The hernial sac is divided by deep constrictions into three parts of unequal size. It is filled by omentum.

XVII. 33.—Part of a large umbilical hernia, the sac of which presents many irregular pouches, and appears in some parts deficient.

Coverings of an umbilical hernia.

The coverings of an umbilical hernia are generally very thin and adherent to one another.

They are:—1, skin; 2, superficial and deep fascia, with a very thin layer of fat between them; 3, fascia transversalis; 4, peritoneum, which constitutes the sac. It must not be expected, however, that these coverings can always be demonstrated in practice. They become so attenuated and adherent to one another, or even perforated in places, that the contents of the hernia are often in contact with the skin, or merely separated from it by a thin layer of fascia.

XVII. 46.—Section of an umbilical hernia containing omentum. The omentum is firmly adherent to the sac, except in one situation, where part of the sac being deficient, the omentum is in contact with the skin.

OBTURATOR HERNIA.

An obturator hernia is one that escapes through the obturator

foramen. The hernia leaves the pelvis through the aperture for the obturator artery and nerve in the upper and outer part of the obturator membrane. It either pushes the obturator externus muscle before it, or it passes over the upper border or through the fibres of that muscle and protrudes under the pectineus behind and a little to the inner side of the femoral vessels. The obturator nerve and artery are generally above the neck of the sac, but their position is not constant; sometimes the nerve is a little to the outer, and the artery a little to the inner side of the hernia. The sac, which is always an acquired one, is formed of the parietal layer of peritoneum which lines the cavity of the pelvis. The contents of the sac have generally consisted of small intestine, frequently of a small portion only of the circumference of the intestine; other viscera, however, have been found in the sac: the intestine has frequently been found adherent to the walls of the sac.

The coverings of an obturator hernia are:—1, skin; 2, superficial and deep fascia; 3, pectineus muscle; 4, external obturator fascia; 5, obturator externus muscle (occasionally); 6, pelvic fascia; 7, peritoneum, which forms the sac.

XVII. 84.—Portion of the front and right side of a pelvis, exhibiting the sac of a small hernia through the obturator foramen. The sac is protruded above the upper edge of the obturator externus muscle and below the obturator nerve. The vas deferens runs round the upper and outer border of the neck of the sac.

From a young man who died with pulmonary phthisis.

XVII. 90.—A portion of the left side of the pelvis, showing a part of the ileum, enveloped by omentum, protruded with its peritoneal sac beneath the obturator externus, lying between the muscle and the obturator fascia. The obturator artery and nerve lie immediately above the hernial sac, the artery being towards its inner and the nerve towards its outer side.

The intestine was closely adherent to its peritoneal sac; but there had not been sufficient constriction to cause its strangulation, and it was doubtful whether the obturator hernia had been from the commencement of the case the sole cause of the constipation and its accompanying symptoms.

From a woman aged forty-seven, who laboured under constipation of three weeks' duration, with its ordinary consequences, amongst which were frequent vomitings of fluid having a strong faecal odour. There existed an omental hernia protruded beneath Poupart's ligament into the thigh, where the omentum had become fixed by adhesions to the peritoneal sac protruded with it. Upon this omental hernia an operation was performed with the effect of replacing the protruded omentum into the abdomen. From this period the symptoms abated in severity, but without any action of the bowels having been obtained.

Subsequently, however, the symptoms returned with increased severity, and the patient sank three weeks from the commencement of the constipation.

DIAPHRAGMATIC HERNIA.

A diaphragmatic hernia is one that protrudes through the diaphragm into the thoracic cavity. The aperture in the diaphragm through which the viscus escapes may be a wound or laceration, or may be due to some congenital deficiency, or to the enlargement of one of the natural openings. The hernia has usually been observed on the left side, the liver tending to prevent any protrusion taking place on the right. The stomach or transverse colon is the viscus that usually escapes; but other portions of the intestine, the omentum, and even the pancreas, have occasionally constituted the hernia. There is no peritoneal sac in diaphragmatic hernia; the viscus commonly passing into the pleural cavity, or, as in XII. 141 (a unique case), into the pericardium.

XVII. 70.—Diaphragmatic hernia. The preparation exhibits a portion of the left lateral half of the diaphragm, in which there is a large opening, presumed to have existed from birth. Through this opening, parts of the arch of the colon, omentum, and pancreas, protruded into the chest. The strangulation of the intestine by the margin of the opening was the cause of death.

The patient, a lad nineteen years old, died with complete obstruction of the intestines of three days' duration.

XVII. 74.—Diaphragmatic hernia, the consequence of a stab through the diaphragm six months before death. Through the aperture in the diaphragm a large portion of the jejunum and ileum, and a part of the arch of the colon, have been protruded.

The patient was a man thirty-one years old. He was always healthy till he stabbed himself below the left nipple. The wound was not considered dangerous, but after it he had several severe attacks of obstruction of the intestines, the last of which was fatal.

XII. 141.—Pericardial diaphragmatic hernia of the omentum. In the skin over the cardiac region a transverse linear scar, nearly an inch in length, was found, a couple of inches below, and about the same distance to the right of the nipple; and corresponding with the position of this scar, the structures occupying the space between the fifth and sixth ribs were found thinned and depressed. At the same spot a piece of the cartilage of the fifth rib lay partly separated from its former connections. All the parts had, however, long healed, the wound, probably a stab, having been almost certainly inflicted many months or years before. The hernia was doubtlessly a consequence of a wound of the floor of the diaphragm, inflicted at the same time as the wound in the chest-walls.

VENTRAL HERNIA.

A ventral hernia is one that protrudes through the abdominal walls in situations other than those of the herniæ already described. In the majority of cases the protrusion occurs in the linea alba, either above or below the umbilicus; more rarely in the linea semilunaris, in the angle formed by the costal cartilages and the ensiform cartilage (epigastric hernia), or in the lumbar region (lumbar hernia).

The coverings when the hernia occurs in the linea alba are skin, superficial and deep fascia, fascia transversalis, subperitoneal fat, and peritoneum.

XVII. 36.—Two herniæ in the linea alba above the umbilicus. The superior and larger sac contains omentum; the lower one is empty. Below the smaller sac is a hole in the linea alba, through which the fat protrudes.

Other rare forms of hernia, such as ischiatic, perineal, rectal, pudendal and vaginal, occur. There are no specimens of any of these in the Museum.

INJURIES AND DISEASES OF THE RECTUM.

PERFORATION OF THE COATS OF THE RECTUM BY A METALLIC
CLYSTER-PIPE.

XVI. 36.—Portion of a rectum from a young person. A quill is passed through an aperture in the upper part of the intestine, where it is covered by peritoneum; this aperture was made by the end of a metallic clyster-pipe. The clyster was injected into the peritoneal cavity and produced fatal peritonitis.

XVI. 93.—The rectum, uterus, and vagina of a child five years old. Ten months before death, in the attempt to administer an enema, a clyster-pipe was forced through the adjacent walls of the rectum and vagina. At the part thus injured there is a small depression in the wall of the vagina, and a long, pale irregular cicatrix in that of the rectum.

FISSURE OF THE ANUS.

By fissure of the anus is meant a small crack or oval ulcer in the folds of mucous membrane surrounding the anus. There is no specimen in the Museum.

ULCERATION OF THE RECTUM.

Ulceration of the rectum may be simple, syphilitic, dysenteric, or cancerous.

Simple Ulceration.

Simple ulceration is generally superficial and limited in extent, but it may penetrate deeply, occasionally perforating the walls of the rectum, and causing ischio-rectal abscess and fistula. Mr. Bryant relates five cases in which it extended into the bladder (an example of such a perforation of the bladder is seen in one of the following specimens, XVI. 34), and in XVI. 69 the ulceration has made its way into the peritoneal cavity. The ulceration, moreover, may sometimes be widely diffused, spreading over a considerable extent of the surface of the mucous membrane, as is shown in XVI. 52, 59, and 64.

The edges of the ulcers when distinct are usually neither indurated nor nodular, and their base does not, as a rule, show any thickening. When the ulceration is superficial the submucous tissue and muscular coat, with the exception of being slightly thickened, are not affected.

XVI. 52.—A rectum, in which there is diffuse superficial ulceration of the mucous membrane. A portion of the mucous membrane is separated from the muscular fibres, which are thickened and increased in firmness.

XVI. 64.—The rectum of a girl twenty-five years old. Its mucous membrane is entirely removed by ulceration for several inches above the anus; and above the ulcerated part it is slightly thickened. The muscular and other coats of the intestine are thicker and denser than is natural, but exhibit no other morbid alteration of their tissue.

XVI. 34.—Portion of a rectum. Just above the anus there are numerous ulcerated apertures, which lead into short fistulous passages in the surrounding tissues; one of these penetrates the coats of the bladder.

XVI. 69.—A rectum. The whole of the mucous membrane for about nine inches above the anus is removed in consequence of ulceration. On the surface thus exposed there are several apertures, which lead to fistulous passages in the tissues around. Upon the anterior aspect of the rectum there is one aperture higher up than the rest, which passes through the walls of the rectum, and which opened directly into the peritoneal cavity. The patient from whom the specimen was taken died from peritonitis.

Syphilitic ulceration.

Syphilitic ulceration of the rectum is generally associated with the growth of condylomata or mucous tubercles about the anus.

"The affection," says Sir James Paget, in a clinical lecture ('Med. Times and Gaz.,' 1865), "commonly extends from the anus, as if by continuity with the excrescences, to about five inches

above the rectum ; but it is rarely so marked in the first inch of the rectum as it is higher up." The characteristic appearance of the ulceration is well seen in the following specimen. The small, regular, round, or oval ulcers seen there in the colon are very suggestive of the breaking down of gummata in the mucous and submucous coats.

XVII. 132.—The rectum and adjacent portion of the colon, laid open, showing syphilitic ulceration of the mucous membrane. The whole mucous membrane of the rectum is destroyed, except in one small patch, which is thickened and opaque. The exposed submucous tissue is uneven, tuberculated, and thickened by infiltration. On the mucous membrane of the colon there are ulcers of regular, round, or oval shape, from one-sixth to about two-thirds of an inch in diameter, with clean, sharply cut, scarcely thickened edges, surrounded by healthy or only too vascular mucous membrane. Their bases are, for the most part, level, flat, or with low granulations resting on submucous tissue, nowhere penetrating to the muscular coat, with no marked subjacent thickening or hardening. On some of them are ramifying blood-vessels; on some few there is, at the centre of the base, a small island of mucous membrane. At some places two or more of these ulcers, extending and uniting, have coalesced into a large ulcer of irregular shape. By such coalescence some of the ulcers in the lower part of the colon are continuous with the ulcerated surface of the rectum, "making it probable that at first similar forms of ulcers may have existed in the rectum, though now superadded thickening and partial scarring have destroyed nearly all traces of any primary shapes of ulcer" (Paget, 'Med. Times and Gazette'). No ulcers were found in the cæcum, or in the small intestine, except one very small and of rather doubtful character in the ileum.

From a woman, aged twenty-eight, who had contracted syphilis seven years previously.

In the clinical lecture before referred to, Sir James Paget, in reference to the ulcers in this specimen, says: "The only question as to the diagnosis of these ulcers may be whether they are syphilitic or tuberculous. They are so different from all the forms of catarrhal, follicular, typhoid, dysenteric, and cancerous ulceration of the rectum, that there is no need to compare them; but from the tuberculous they must be distinguished, not so much because of any near resemblance between them, but because the patient had tuberculous disease of the lungs, and was therefore not unlikely to have it in the intestines."

"The shape and characters of the ulcers are quite unlike those of intestinal tuberculosis; they are regular, with sharp, even, well-defined edges, with level bases; they are not excavated; they do not extend through the submucous tissue; their edges are nowhere eroded or undermined, sinuous, thickened or brawny, or

infiltrated; the subjacent and intervening structures appear healthy, except at the rectum. These ulcers are not grouped, and when, by extension and coalescence, they have lost their first shape, they have acquired one altogether irregular, and have in no instance even tended towards that girdle-like shape encircling the canal of the intestine, which is so characteristic in the large coalesced tuberculous ulcers."

XVI. 138.—The rectum of a woman, aged thirty, affected by what was supposed to be tertiary syphilitic ulceration.

XVI. 139.—A portion of the large intestine, from the same patient, showing the alternation of a healthy with a diseased tract of mucous membrane.

Dysenteric ulceration.

There are no specimens of dysenteric ulceration of the rectum in the Museum. The characters of the dysenteric ulcer, however, are well seen in several specimens of dysenteric ulceration of the colon, the common seat of the affection (XVI. 108 to 116, 126, &c.).

Cancerous ulceration.

For description and specimens of cancerous ulceration see "Cancerous Stricture of the Rectum."

FISTULA IN ANO.

Fistula in ano may be defined as a fistulous tract by the side of the rectum, left by the contraction of the cavity of an ischio-rectal abscess.

The way in which an ischio-rectal abscess, and consequently a fistula, is produced was long a matter of controversy. Sir Benjamin Brodie held the opinion that all ischio-rectal abscesses were the result of ulceration of the mucous membrane, and subsequent perforation of the walls of the rectum and escape of fæces into the ischio-rectal fossa, and, therefore, that all fistulæ communicated with the rectum. Others, however, maintained that an abscess might form in the ischio-rectal fossa from causes other than perforation of the rectum, such as various constitutional conditions of the patient, blows or kicks upon the nates, &c., and, therefore, that should a fistula result from the imperfect healing of such an abscess it need not necessarily communicate with the bowel.

It is now universally recognized that an abscess, and consequently a fistula, may be produced in either way, and that an internal opening does not always exist. It is difficult, however, in the living to be quite sure that there is no internal opening. In

the Museum there are two specimens in which its absence is clearly demonstrated.

A recognition of the fact that an ischio-rectal abscess may be the result of causes other than ulceration and perforation of the rectum is of importance, for should such an abscess be opened early it may be prevented from making its way into the rectum, and under appropriate treatment may completely and soundly heal without the production of any fistula; whereas should the opening be delayed until the abscess points externally it will certainly by that time have burst into the bowel, and a fistula will be the result.

Some authors declare that a fistula is more often the result of a cutaneous abscess situated over the ischio-rectal fossa, than of a true ischio-rectal abscess; but as such a difference of situation is one merely of degree and not of kind it is hardly worthy of recognition.

The frequent termination of an ischio-rectal abscess in a fistula is due to the constant action of the sphincter and the contraction of the levator ani during defæcation, which prevent the walls of the contracted abscess-cavity from uniting. After the fistula has existed some time the smooth membrane with which it becomes lined is an additional hinderance to the healing process.

Fistulæ are divided into complete, blind external, and blind internal. A *complete* is one which opens externally upon the cutaneous surface and internally into the bowel. A *blind external* is one that opens on the cutaneous surface, but has no internal opening into the bowel. A *blind internal* is one that opens into the bowel, but has no external opening upon the cutaneous surface.

As a fistula is the result of the contraction of an ischio-rectal abscess it will be lined when first formed by granulations, but after it has existed some time its walls become hard, indurated, and lined by a smooth shining membrane.

In direction the fistula usually extends obliquely upwards and inwards on one side of the rectum, and when complete generally opens into the gut immediately above the internal sphincter. Occasionally, however, it extends for some distance above the internal opening in the form of a cul-de-sac by the side of the rectum. Occasionally the internal opening has been found as high as three or more inches up the rectum, and occasionally two internal openings have existed. Secondary fistulæ frequently burrow beneath the skin of the perinæum and buttock, forming angles, as it were, with the deep fistula. There is usually but one external opening, but occasionally there may be several. When single the opening is usually about half an inch from the verge of

the anus, but it may be at some distance from the anus, or close to it, and so enveloped in the loose folds of integument that it is often difficult to discover it. It may be little more than a minute aperture, only discernible by the slight discharge which oozes from it, or it may appear as a minute hole slightly elevated on a papilla.

The internal opening is often difficult to find; it generally lies hidden in the fold of mucous membrane immediately above the sphincter.

A fistula is often associated with cancerous or other form of stricture of the rectum.

Complete fistula.

XVI. 50.—Portion of a rectum, with a fistula extending for two inches upwards on its exterior, and then suddenly opening into its cavity. The passage appears lined by a smooth membrane, like the mucous membrane of the rectum itself.

Blind external fistula.

XVI. 35.—Portion of a rectum, exhibiting a fistula which extends from the anus upwards between the fibres of the levator ani muscle and the longitudinal muscular fibres of the intestine. A bristle is passed through the fistulous passage; it does not open into the rectum.

XVI. 46.—Portion of a rectum, with the anus. Irregular and branched fistulous passages, whose course is indicated by bristles, extend in various directions around the exterior of the rectum, but none of them open into it. They appear lined by soft and smooth membrane.

Blind internal fistula.

XVI. 34.—Portion of a rectum. Its coats are generally and greatly thickened, indurated, and consolidated with each other and with the remaining parts. Just above the anus there are numerous ulcerated apertures with smooth edges, which lead into short fistulous canals in the surrounding indurated tissues. One of these canals extends beyond this tissue through the coats of the bladder into its cavity.

HÆMORRHOIDS OR PILES.

Hæmorrhoids or piles may be defined as swellings about the anus, the result of the dilatation or varicose state of the hæmorrhoidal veins. Before studying the specimens illustrating the anatomy of piles the normal arrangement of the hæmorrhoidal veins should be noticed (see Physiological Series, XII. 14). The hæmorrhoidal plexus is situated between the mucous and muscular coat of the lower part of the rectum, and extends from the inner margin of the external sphincter for about three quarters of an

inch up the gut. The veins are arranged in clusters, principally longitudinally, anastomosing with one another by transverse loops. Above, they communicate through the middle and superior hæmorrhoidal, the inferior mesenteric, and splenic veins with the portal vein, all of which are destitute of valves; below, branches perforate the internal sphincter, establishing a communication with the subcutaneous veins (the external hæmorrhoidal) around the margin of the anus, which terminate in the internal pudic. The peculiar anatomical arrangement of the hæmorrhoidal veins; the absence of valves in the veins through which they communicate with the portal vein, whereby they have to sustain the whole weight of the column of portal blood; and their situation between the muscular and mucous coats of the rectum, so that they receive but little support during defæcation, should be noted, as these conditions constitute the chief predisposing causes of hæmorrhoids.

Hæmorrhoids consist at first of little more than dilated hæmorrhoidal veins, and appear as swellings situated around the margin of the anus external to the sphincter, or in the interior of the lower part of the rectum; but after they have existed some time the vein-walls become hypertrophied, and the connective tissue surrounding the dilated veins becomes infiltrated and thickened. They then appear composed in great part of connective tissue and a number of small blood-vessels. From the fact that hæmorrhoids are occasionally produced quite suddenly, it is probable that they may in some cases be due to rupture of a vein and extravasation of blood into the connective tissue around. When situated without the sphincter they are covered in part by skin and in part by mucous membrane, and are called external hæmorrhoids; when situated in the interior of the rectum they are covered only by mucous membrane, and are called internal hæmorrhoids.

External hæmorrhoids occur in two forms—either as soft, globular, pinkish-blue swellings, or as moderately firm fleshy tumours: the former are composed of varicose and dilated veins containing fluid or clotted blood; the latter, which are the result of secondary changes occurring in the former, consist of thickened skin and infiltrated connective tissue with small vessels ramifying in them.

XVI. 43.—Portion of a rectum with hæmorrhoids. The surface of the hæmorrhoids are formed partly by the mucous membrane of the rectum and partly by the external integuments, thickened and raised in irregular folds around the margin of the anus.

Internal hæmorrhoids (i.e. those occurring within the sphincter) are identical in their nature with those situated externally; they present certain peculiarities in appearance, however, inasmuch as they are covered with mucous membrane, and not with skin. They

occur in many forms. They may consist merely of the smaller hæmorrhoidal veins dilated and varicose, giving to the mucous membrane a dark purplish colour, and rendering it liable to become prolapsed during defæcation; or they may form either slightly raised, flattish and oblong, or distinctly globular pedunculated swellings. These swellings may be very vascular from the congested state of the mucous membrane covering them (bleeding piles); or if the mucous membrane has become thickened they appear firm and fleshy, of a reddish-brown colour, and do not easily bleed. The bleeding appears to take place from the small arteries in the mucous membrane, and not from the dilated veins. The globular kinds have often a distinct artery entering at their base, which may bleed freely if the pile is excised.

Internal hæmorrhoids are liable to be protruded during defæcation, and to become strangulated by the sphincter, causing much pain and irritation. If not soon reduced the constricted part may become gangrenous and separate.

Whether external or internal, hæmorrhoids may become inflamed and suppurate. They are also frequently associated with fissure, fistula, prolapse, or other affections of the rectum.

XVI. 38.—A rectum, around the lower part of which the veins, dilated into hæmorrhoidal tumours, have been filled with wax injected into the inferior mesenteric vein.

XVI. 27.—Portion of a rectum. At its lower border the mucous membrane is raised in folds and lobular tumours by the hæmorrhoidal enlargement of the subjacent veins.

XVI. 119.—A prolapsed rectum. A section has been made through the anterior wall, in which numerous clots of blood are conspicuous and denote the situation of dilated hæmorrhoidal veins.

XVI. 103.—A pyriform clot of blood, firm and dark, which was removed from a dilated portion of an hæmorrhoidal vein.

PROLAPSUS ANI.

Prolapsus ani is the name given to the protrusion of the lower part of the rectum through the anus. It may result from a relaxed state of the sphincter ani, or from straining in consequence of constipation, diarrhœa, hæmorrhoids, stricture of the urethra, stone in the bladder, polypus or ascarides in the rectum, &c. It is most frequently met with in children.

The protrusion commonly appears as an irregular ring of mucous membrane, or, when much of the rectum is protruded, as an elongated cylindrical swelling slightly inclining to one side with a central depression at its lowest part.

The lateral inclination and retraction of its lowest part is due to

the dragging of the meso-rectum, which is, of course, drawn down when much of the rectum is protruded. This dragging of the meso-rectum also accounts for the slit-like appearance which the aperture at the bottom of the central depression (the entrance into the bowel), sometimes assumes. When recent the protruded part has the colour of healthy mucous membrane, but if not soon reduced it becomes livid and congested in consequence of the constriction of its blood-vessels by the sphincter; in old-standing cases it becomes indurated and leathery from exposure, approaching in character to skin. The protruded portion in some cases is ulcerated. Prolapse of the rectum may be distinguished from a protruding polypus by the aperture in the centre of the prolapsed gut, and from an intussusception of the rectum or other part of the intestine protruding through the anus by the mucous membrane in the case of prolapse being continuous with that of the sphincter, whereas in intussusception a sulcus exists between the protruded part of the bowel and the sphincter.

XVI. 119.—A prolapsed rectum. The mucous lining of the most dependent portion is much thickened, forming great part of the fibro-cellular mass which protruded through the anus. A section has been made through the anterior wall, showing this thickened portion, in which numerous clots of blood are conspicuous, and denote the situation of dilated hæmorrhoidal veins.

POLYPI OF THE RECTUM.

Polypi occur as pear-shaped pedunculated growths springing from the submucous tissue of the rectum, and more commonly from that of the lower and posterior portion. They are covered with the mucous membrane, which they resemble in colour, and are generally very vascular, giving rise to frequent hæmorrhages, especially in children. They are usually single, and vary from the size of a pea to that of a large nut. Their peduncle, which is generally slender, is often more than an inch in length, allowing them to protrude externally during defæcation. In structure they differ and have been divided into the soft or glandular, and the hard or fibrous; the former variety mostly occurring in children, the latter in adults.

The gelatinous, soft, or glandular, approach the myxomata or adenomata in structure, and are composed of a number of follicles lined by cylindrical epithelium bound together by soft mucoid connective tissue. Their peduncle is generally soft and readily broken.

XVI. 95.—Sections of a polypus of the rectum. It is an oval flattened mass, about two-thirds of an inch in its greatest diameter. It

was attached by a very slender pedicle, nearly an inch long, to the anterior wall of the rectum just above the margin of the sphincter. It protruded at the anus, covered with high-coloured mucous membrane that was tinged with blood. The texture was firm, greyish, very succulent, and it included a few small cavities full of a clear, yellowish, viscid fluid. In minute structure it appeared in every part composed of disorderly clusters of small tubular glands like those of the natural mucous membrane of the rectum. The clusters of glands were partitioned by small quantities of fibro-cellular tissue. The patient was a boy, four years old. The growth had been observed six months.

XVI. 130.—A large polypus of the rectum from a man aged forty. Symptoms had existed for ten years, and for two or three years the fæces had never passed without much straining and discharge, occasionally of blood. Before removal the polypus could be felt in the rectum, nearly four inches from the anus, attached to the posterior wall of the bowel. When protruded by long straining it appeared as an irregular spheroidal mass, lobed, moderately firm, but brittle, about two and a half inches in its chief diameter, and like the adjacent mucous membrane readily but not freely bleeding. Its base of attachment seemed to be rather more than an inch in diameter.

Under the microscope the tumour was seen to be composed of small cells like gland-cells and a small quantity of fibro-cellular tissue. Numerous papillæ were found with loops of capillaries in their interior, and covered with cylindrical epithelium. Upon a careful examination of the rectum a short time after the removal of the tumour no trace of it could be discovered.

XVI. 134.—A fibro-gelatinous polypus removed from the rectum of a gentleman about forty years old.

The *hard or fibrous* are composed almost entirely of fibrous tissue, and their peduncles are tough and not readily broken.

XVI. 124.—A fibrous polypus removed from the lower part of the rectum. It is covered with a structure resembling mucous membrane, which, however, over portions, has the character of common integument and long silken hairs grow from its surface.

VILLOUS TUMOURS.

Villous tumours of the rectum are rare; they resemble the villous growths in the bladder, and, like these, are of true papillomatous structure. They spring from the mucous membrane, and give rise to frequent hæmorrhage. There is no specimen of them in the Museum.

STRICTURE.

Stricture of the rectum is commonly divided into simple and malignant.

Simple stricture.

Simple stricture is caused either by the fibroid contraction of inflammatory products resulting from inflammation of the mucous and submucous coats, or by the contraction of cicatrices following ulceration or injury of the bowel. Syphilitic and dysenteric ulceration more frequently give rise to stricture than simple ulceration, as they involve the submucous coat, and in the case of dysenteric ulceration the muscular coat also; whereas simple ulceration is usually confined to the mucous membrane. There is a specimen in the Museum exhibiting a permanent stricture without any visible change of structure, attributed to contraction of the muscular coat.

The stricture may involve a small portion only of the intestine, assuming a ring-like form, when it is called annular; or it may include an inch or more of the gut.

The strictured portion of the bowel is composed in great part of fibrous tissue.

Simple stricture is most commonly met with from one to two inches from the anus, but it may also occur at the junction of the first and second portions of the rectum, *i. e.* from four to five inches from the anus, and at the junction of the sigmoid flexure with the rectum.

XVI. 131.—Portion of a rectum, the cavity of which, at its upper part, is contracted to a quarter of an inch in diameter, without any visible change of structure. The contraction includes about an inch of the length of the intestine; it was probably occasioned by the action of the muscular fibres.

XVI. 32.—Portion of a rectum exhibiting a very close annular stricture between two and three inches from the anus.

XVI. 139.—A rectum, with a portion of the sigmoid flexure of the colon. The rectum presents an annular contraction with thickening, induration, and superficial ulceration of its coats in the line of its junction with the sigmoid flexure. The contraction of the rectum was so close and firm that a finger could not be passed through it. The sigmoid flexure is dilated and hypertrophied. Except at the annular contraction the rectum is healthy.

XVI. 140.—Annular stricture of the rectum, situate eight inches from the anus, and polypoid thickening of the mucous membrane at the seat of stricture, causing nearly complete obstruction of the canal. Microscopic examination showed that the thickening of the mucous membrane was not cancerous. From a patient (female, aged fifty-six) on whom the operation of colotomy was performed on the right side for the relief of obstruction caused by the stricture. The patient died on the day following the operation from peritonitis.

XVI. 98.—Portion of the sigmoid flexure of a colon, presenting an annular constriction, at which its canal is reduced to a quarter of an

inch in diameter. The constriction occupies about half an inch of the length of the canal; on its exterior it is marked by a drawing inwards of the wall of the intestine, as if a cord had been tied round it; and within, there is no appearance of morbid growth; the mucous membrane is only slightly raised and villous. A piece of omentum is adherent to the exterior of the intestine at the strictured part; and all the tissues engaged in it appear indurated and confused.

XVI. 93.—The rectum, uterus, and vagina of a child five years old. Ten months before the death of the child, in the attempt to administer an enema, a clyster-pipe was forced through the adjacent walls of the rectum and vagina. At the part thus injured there is a small depression in the wall of the vagina, and a long, pale, and irregular cicatrix in that of the rectum. Just below the cicatrix, at a distance of about an inch from the margin of the anus, the canal of the rectum is reduced to an eighth of an inch in diameter, and the adjacent tissues are indurated. Above this stricture the intestine is greatly dilated; below, it is of natural size.

Malignant or cancerous stricture.

All forms of cancer occur in the rectum, and by encroaching upon the lumen of the gut may give rise to stricture. Epithelial cancer is the most common; it may begin as a cauliflower-excrecence, protruding into the rectum, or as a hard nodular ring-like induration of the mucous membrane. The surface of the growth after a time ulcerates, the ulcer having elevated edges and an indurated base covered with a sanious offensive discharge. It is most common round the anus and at a distance of from two to five inches up the rectum.

Epithelial cancer of the rectum is nearly always of that variety called adenoid or glandular cancer. "The growth proceeds almost exclusively from the glands of the rectum, which grow out in the form of elongated, and sometimes branched, saccules; the lumina of the glands are often preserved and filled with mucus; the cylindrical epithelium retains its form and becomes very large. The interstitial connective tissue becomes infiltrated with small round cells; it undergoes a partial mucoid softening, and is very vascular" (Billroth).

Should the patient soon succumb to intestinal obstruction the disease will seldom be found involving the neighbouring parts, but when the patient survives for some time, as after a successful colotomy, the cancer infiltrates adjacent structures, gluing them to the rectum, converting the whole into a cancerous mass, and causing death by interfering with their functions.

The scirrhus form of cancer generally occurs as an infiltration of the coats, converting the portion of the gut involved into a rigid

tube, and afterwards, by its contraction, producing complete obstruction. The encephaloid and colloid forms are rare.

XVI. 106.—The lower part of a rectum with the urinary bladder and an enlarged prostate. The rectum is the seat of extensive epithelial cancer. Softening and disintegrating, it has made its way into the bladder, involving its mucous lining, and projecting into its interior soft fungous granulations. A free communication exists, as indicated by the director passed from the bladder into the rectum. The prostate is enlarged, chiefly upwards, in its lateral lobes, and the prostatic bar stretches across the neck of the bladder.

The disease was of two years' duration, and proved fatal by exhaustion, consequent upon repeated hæmorrhages.

XVI. 99.—Portion of a rectum and of the sigmoid flexure of the colon. There is an annular constriction at the point of junction of these two portions of the large intestine, and the canal is still further obstructed by the projection of a cancerous growth into its interior. The rectum itself appears healthy, but the colon is greatly dilated, and its walls much hypertrophied.

The patient, a middle-aged woman, died in the hospital after five weeks' suffering from complete obstruction of the intestinal canal. The cæcum gave way in several places before death, and peritonitis ensued, consequent upon the escape of fæcal matter.

XVI. 56.—A rectum and urinary bladder. Cancer, arising from the mucous membrane of the rectum in its whole circumference, projects into the cavity of the intestine, from the anus for about four inches upwards. The cellular tissue between the bladder and rectum is thickened and indurated.

XVI. 68.—Portion of a rectum. At a distance of about three inches from the anus, the greater part of the circumference of the intestine is occupied by a firm cancerous mass growing from beneath its mucous membrane. The mucous membrane is healthy. The tissues around that part of the rectum which is occupied by the morbid structure, are thickened and condensed. Some lymphatic glands behind the rectum are enlarged, and filled by a substance similar to that of which the tumour is composed.

The patient was a woman forty years old. She died extremely emaciated, with cancerous tumours in the liver and other parts. She had made no complaint leading to a suspicion of disease of the rectum.

XVI. 33.—A rectum exhibiting a contraction of its cavity, which commenced two inches above the anus, and is thence continued four or five inches upwards. The coats of the intestine are generally thickened and indurated, and the divided edges exhibit white bands intersecting a very firm mass of scirrhus cancer. The cellular and adipose tissue around the rectum is also thickened, and is converted into a hard brawny mass of cancer, in which the posterior surfaces of the uterus, vagina, and broad ligaments are involved.

XVI. 42.—A rectum, in which distinct masses of soft, spongy (cancerous) substance have grown from the mucous membrane for

about three inches above the anus. Around these masses its coats are thickened and ulcerated.

XVI. 47.—A rectum exhibiting a contraction of its canal, which commences an inch above the anus, and is continued five inches up the intestine. The coats of the intestine are generally thickened, and of very dense texture; the mucous membrane in some situations is tuberculated, and in others ulcerated. The cellular and adipose tissue around the intestine is indurated. A portion of the coats of the bladder has undergone the same change of structure as the coats of the rectum.

The effects upon the intestine above the seat of stricture.

Whatever the kind and position of the stricture, the intestine above the stricture becomes much distended by fæces, the muscular coat becomes hypertrophied, and the mucous membrane thickened and frequently ulcerated. Sometimes the distension is so great that the walls give way, and extravasation into the peritoneal cavity ensues.

Fistula and hæmorrhoids are frequent concomitants of stricture; their presence has occasionally caused the existence of stricture to be overlooked.

XVI. 32.—Portion of a rectum exhibiting a very close annular stricture between two and three inches from the anus. Above the stricture the intestine is dilated, and its muscular coat is thickened and hypertrophied; below it there is diffuse superficial ulceration of the mucous membrane. A portion of quill is passed through the strictured part.

XVI. 94.—The large intestine, enormously distended, taken from a child with stricture of the rectum. It contained a large bucketful of fluid fæcal matter, which had been gradually accumulating from the time of the formation of the stricture, which is seen in XVI. 93.

CONGENITAL MALFORMATIONS.

IMPERFORATE ANUS.

The intestinal canal in early foetal life terminates, as may be remembered, at some little distance from the cutaneous surface as a blind pouch or cloaca, common to it and the genito-urinary organs. As development advances, the cutaneous tissues (epiblast) at the spot corresponding to the future anus become invaginated towards the cloaca, the intervening tissues and walls of the cloaca become gradually thinned and at length completely absorbed, and a connection is established between the cloaca and the surface of the body.

Subsequently the anterior or genito-urinary portion of the cloaca becomes cut off from the posterior or intestinal, the latter retaining its connection with the external opening, which is then called the anus. The various forms of imperforate anus may be explained by the failure of one or more of the above processes of development.

I. Should no invagination of the cutaneous tissues take place, the anus will be entirely wanting. The intestine in such a case may terminate in a blind pouch, a moderate thickness of tissue or a thin membrane alone intervening between it and the outer surface; or it may communicate (should the process by which the intestine is normally cut off from the genito-urinary portion of the cloaca also have failed) with any of the genito-urinary organs, *i. e.* with the bladder, urethra or vagina (fæcal fistulæ); or again, it may open externally in some abnormal situation such as the perinæum or groin, a condition somewhat difficult of explanation. In some instances the rectum itself may be entirely absent.

II. Should invagination of the cutaneous tissue have taken place, but the communication between the cloaca and the surface not have been accomplished by the absorption of the intervening tissues, an anus, natural to all outward appearances and in a normal situation, will exist, but will terminate inwardly as a blind pouch, soft tissue, varying from a thin membrane to a considerable thickness, intervening between the top of the pouch and the end of the intestine. In such a case the rectum itself, as when the anus is entirely absent, may terminate blindly, or in one of the forms of fæcal fistulæ.

A. 16.—The rectum of a child with imperforate anus. The rectum terminates more than half an inch above the anus, and above this point forms a sac about five inches in length and four inches in diameter.

A. 17.—The rectum, bladder, and other parts from a similar case of malformation. The cutaneous and subcutaneous portions of the anus appear well formed, a conical depression from the perinæum, with converging folds of skin and mucous membrane, existing as in the natural state. But the space between this depression and the closed termination of the rectum is filled with cellular tissue in a layer between one and two lines thick. Directly above this layer the rectum is dilated in a large pouch.

A. 18.—A rectum and bladder. The rectum terminates in a cul-de-sac about an inch from the anus.

A. 19.—A similar malformation of the rectum and anus. A layer of cellular tissue, nearly an inch in depth, intervenes between the depression and the closed end of the intestine. A large rupture of the colon, about four inches from the cæcum, was occasioned by the accumulation of fæcal matter.

A. 20.—A similar malformation, in which, as in Nos. 14 and 16, the anal depression is well formed and more than half an inch deep, but between it and the dilated termination of the rectum an interval of nearly an inch deep is filled with cellular tissue. A bristle is placed in an aperture in the end of the rectum made with a trochar in an attempt to give passage to the fæces.

A. 21.—A similar specimen, but the trochar passed by the side of the rectum and did not enter it.

A. 22.—The rectum of a child fourteen months old, in which at birth the anus was imperforate. The rectum was punctured from the anus with a trochar and the aperture remained open for the passage of fæces. Where the partition existed between the rectum and anus there is now an annular fold of mucous membrane projecting like a perforated diaphragm into the canal of the intestine about two-thirds of an inch from the anus. At this fold the mucous membrane is smooth and appears very dense; above and below it is deeply wrinkled. The muscular coat of the rectum above the fold is very thick.

A. 23.—A similar specimen from a child who lived two years after the puncture of the rectum. The tissues punctured appear to have been torn or cut in making the preparation; but the insufficiency of the aperture is proved by the great distension, the thick muscular walls, and the large follicles of the rectum above it.

CHAPTER XIII.

INJURIES AND DISEASES OF THE GENITO- URINARY ORGANS.

INJURIES AND DISEASES OF THE PENIS AND URETHRA.

WARTS ON THE PENIS.

WARTS on the glans and prepuce are very common as the result of gonorrhœa. When abundant they somewhat resemble epithelioma, from which they may generally be distinguished by the absence of induration.

XXX. 27.—Portion of a penis with warts upon the prepuce and upon the surface of the glans. Previous to the growth of these the glans appears to have protruded through an ulcerated aperture in the lower part of the prepuce.

CANCER OF THE PENIS.

Cancer of the penis is generally epithelial, occasionally scirrhus.

The epithelial variety begins usually as a warty excrescence on the inner surface of the prepuce, more rarely as a circumscribed nodular induration of the glans itself. As it increases in size it assumes the form of an indurated, irregular, cauliflower-like growth covered with a sanious offensive discharge.

The cancer involves the whole of the organ, and thence spreads to the neighbouring parts. The inguinal glands are affected, but secondary deposits in distant organs do not occur. If amputation is performed sufficiently early the disease may not return, but if amputation be delayed until the glands have become implicated the cancer generally recurs in the cicatrix or in the glands.

XXX. 35.—The greater part of a penis removed together with a very large warty growth, which covers all its upper and anterior part, and appears to have originated in the skin of the prepuce. The glans and body of the penis are healthy.

See also XXX. 42.

The scirrhus variety begins either as an infiltration or as a distinct tubercle in the neighbourhood of the corona glandis. It rapidly invades the remainder of the organ, ulcerates, affects the neighbouring glands, and gives rise to secondary cancer in distant organs.

XXX. 24.—Portion of a penis, in which the corpus cavernosum is converted by cancerous disease into a firm substance. The glans penis with a part of the altered corpus cavernosum is deeply ulcerated.

XXX. 36.—Sections of a penis which was removed in consequence of extensive cancerous disease. In the lower half of the prepuce is a mass of firm cancer. The part of this mass which is near the glans has ulcerated deeply, and the lower half of the glans itself is similarly destroyed. The remains of the glans and anterior third of the corpus spongiosum appeared filled with cancer, and there is a nearly isolated mass of cancer in the corpus cavernosum, just behind the glans.

From a man seventy-five years old. The disease had been eighteen months in progress. The penis was cut off close to the pubes. A week after the operation the patient died of erysipelas. After death the inguinal and lumbar glands were found enlarged with cancerous disease, and there were several small, white, hard, cancerous tumours in the lungs.

XXX. 41.—Scirrhus cancer of the penis and bladder.

PRIMARY SYPHILITIC SORES ON THE PENIS.

Two specimens of phagedænic ulceration of the glans, the result of venereal inoculation, follow. The appearances and behaviour of primary venereal sores are not described, as they can be better studied clinically in the living patient.

XXX. 25.—A glans penis, exhibiting a large ulcer, with a ragged irregular surface extending from below into the urethra.

XXX. 26.—Section of a penis, in which the glans and part of the corpus cavernosum have been removed by ulceration.

TUBERCLE OF THE PENIS.

XXX. 31.—Section of a penis, in which tuberculous matter is infiltrated through the whole of the interior of the corpus cavernosum. On a small separated portion the fibrous covering has been reflected to show that it is unaltered. The cavity of the vena dorsalis is filled with tuberculous matter(?) The corpus spongiosum and the urethra are sound.

From the same patient as the tuberculous kidney in XXVI. 18.

STRICTURE OF THE URETHRA.

Anatomy of the urethra.

Before discussing the pathology of stricture, a few remarks on the anatomy of the urethra may not be out of place. The urethra is about eight inches long, and, when the penis is held straight, forms a single curve, with its concavity upwards, under the arch of the pubes. Anatomically it is divided into three portions, the prostatic, the membranous, and the spongy. The prostatic, surrounded by the prostate, measures a little more than an inch in length; the membranous, placed between the two layers of the triangular ligament and surrounded by the compressor urethræ muscle, measures a little less than an inch; and the spongy, surrounded by the corpus spongiosum, about six inches. It is narrowest at the meatus and at the junction of the spongy with the membranous portion, that is, where it passes through the anterior layer of the triangular ligament. Immediately external to the mucous membrane the urethra is surrounded by a layer of unstripped muscular fibres.

XXXI*. 29.—A lateral section of the bladder and penis to illustrate the course of the urethra under the arch of the pubes.

XXXI*. 30.—The anterior part of a pelvis, with the bulbous and membranous portions of the urethra shown in their relations to the triangular ligament.

XXXI*. 11.—Cast in wax of the urethra, to show its average length and the proportionate sizes of its several parts.

XXXI*. 9.—A penis, with the prostate and Cowper's glands. The urethra is laid open.

XXXI*. 12.—A urethra, with the blood-vessels of the corpus spongiosum injected, and its canal laid open from below.

Varieties of stricture.

Three forms of stricture are described, the spasmodic, the congestive, and the organic. The *spasmodic*, depending upon spasm of the unstripped muscular fibres surrounding the urethra, and the *congestive*, depending upon congestion of the capillaries of the mucous membrane, as they both disappear after death, will not be further referred to; and may be dismissed with the remark that they frequently occur as passing complications in patients suffering from organic stricture, and are seldom met with save when some amount of organic stricture exists.

* Specimens marked with an asterisk will be found in the Physiological series.

ORGANIC STRICTURE.

Organic stricture is a contraction of the canal of the urethra in consequence of organic change in the mucous and submucous tissues the result of inflammation or injury. It is generally caused by a protracted gonorrhœa or gleet, the fibroid thickening and contraction of the inflammatory material reducing the lumen of the canal. It may also occur after syphilitic sores, abrasions from the careless passage of catheters, use of injections of too great strength, or after wounds and lacerations from external violence, such as a blow or fall upon the perinæum (traumatic stricture). In the latter cases it is produced by the contraction of cicatrices.

Seat of organic stricture,

Stricture may occur in any part of the urethra save the prostatic. It is most common in the posterior part of the spongy portion immediately in front of the anterior layer of the triangular ligament. According to the statistics collected by Sir Henry Thompson sixty-seven per cent. of strictures occur in that part of the urethra which extends from an inch in front of, to three-quarters of an inch behind, the junction of the spongy and membranous portions, seventeen per cent. in that part which extends from the meatus to two inches and a half up the passage, and sixteen per cent. in that part which is between the two above mentioned.

Varieties of organic stricture.

Several varieties of organic stricture, such as the linear, the annular, the bridle or packthread, the cartilaginous, and the resilient or elastic, have been described.

Linear stricture.—XXX. 3.—Section of a urethra, in which there is a linear stricture about two inches anterior to the bulb. The stricture occupies only a small portion of the length of the urethra, the induration and contraction of the canal being marked merely by an opaque white line.

Annular stricture.—XXX. 9.—A lateral section of a bladder and urethra. There is an annular stricture, that is, a ring-like induration, immediately before the bulb.

The annular differs from the linear merely in the greater width of the ring-like induration of the mucous membrane. The distinction is a refinement hardly worthy of mention.

Packthread or bridle stricture.—XXX. 37.—A penis, in which the canal of the urethra is traversed by eleven distinct cords or bands. These bands are flat and narrow, and attached at their extremities to

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the wall of the urethra. They lay close to the wall of the canal, but are now raised by portions of glass passing beneath them.

From a man in whom instruments had been passed very frequently for the cure of stricture.

Some have supposed these bands to be stretched inflammatory adhesions. More probably they are portions of mucous membrane which have been separated from the urethral walls by an instrument, which after perforating the mucous membrane returned into the canal by a second perforation.

Cartilaginous or gristly stricture. XXX. 20.—A penis, exhibiting a stricture of the urethra about an inch anterior to the bulb. The mucous membrane is thickened, indurated, and cartilaginous in the situation of the stricture.

THE CONSEQUENCES OF STRICTURE.

When a stricture has existed some time, important structural changes occur in the urinary apparatus on the proximal side of the lesion, as the result of the mechanical obstruction to the outflow of urine. The urethra behind the stricture, the bladder, the ureters, and the kidneys, become affected in various ways, and as regards time generally in the above order. The changes liable to occur in the several parts are as follows :

A. *Changes in the urethra behind the seat of stricture.*

1. *Dilatation and thickening.*

XXX. 3.—Section of a urethra, in which there is a stricture in the spongy portion. The urethra behind the stricture is dilated, and its walls thickened.

See also XXX. 7, 9, 15, 21.

2. *Ulceration and its consequences.*

Ulceration of the walls of the urethra behind the seat of stricture is a common complication ; it may be only superficial, or it may extend deeply, perforating the walls of the urethra.

Under the latter circumstances the urine may be forced by the contraction of the bladder into the cellular tissue of the scrotum, perinæum, and groin (extravasation of urine) ; or, as is more commonly the case, the first few drops of urine that escape set up inflammation, the tissues immediately around become sealed by plastic effusion, further extravasation is prevented, and a urinary abscess is the result. The abscess makes its way to the surface, and, after bursting or being opened, the escape of urine may prevent its healing, and a fistulous passage is then left, extending from the cutaneous surface to the urethra (urinary fistula). Although urinary-abscesses and -fistulæ are generally produced in the manner

above described, it must not be forgotten that abscesses not connected with the urethra may occasionally form around that passage, and by bursting, both internally into the urethra and externally upon the integument, may also be productive of urinary fistulæ. According as the fistulæ are situated in the perinæum, scrotum, or the body of the penis, they are spoken of as perineal, scrotal, or penile.

Superficial ulceration. XXX. 21. A penis, exhibiting a stricture two inches and a half from the external orifice. The mucous membrane behind the stricture is in part superficially ulcerated.

Extravasation of urine. XXX. 32.—A bladder and urethra, with a stricture at the bulbous part. A large opening exists in the urethra at the junction of the bulbous with the membranous portion; it was formed by ulceration, and through it urine was effused into the perinæum.

XXX. 16.—A bladder and urethra. There is a stricture of the urethra at the bulb, and in the anterior part of its membranous portion. The mucous membrane has ulcerated in the situation of the stricture. Ulceration has also taken place through the prostate and the adjacent coats of the bladder at its lower and back part, and the aperture thus formed leads to a large irregular cavity resulting from the effusion of urine into the cellular tissue between the bladder and the rectum.

Effusion of urine in this situation is rare; it usually occurs in front of the triangular ligament, which structure prevents the urine from making its way into the pelvis.

Urinary abscess. XXX. 21.—A penis, exhibiting a stricture of the urethra. Behind the stricture the whole urethral canal is greatly dilated, its walls are thickened, and its mucous membrane is deeply folded, and, in parts, superficially ulcerated. There are several small sacs, like the cavities of abscesses, close to the urethra; two of these communicate with its canal close to the prostate.

Ulceration and fistule. XXX. 2.—The anterior part of a penis, with a stricture in the spongy portion of the urethra, about two inches from the external orifice. Behind the stricture the canal is dilated; its walls also are thickened and penetrated by an ulcerated aperture, which leads into a fistulous passage extending to the integuments.

XXX. 5.—Section of a penis, exhibiting a very close stricture in the spongy portion of the urethra, about three inches from the external orifice. Ulceration of the urethra has taken place at the seat of the stricture, and has extended through the indurated tissues around it, and into numerous fistulous passages in the parts between the stricture and the bladder.

See also XXX. 8, 12, and 33.

Sloughing. XXX. 17.—A bladder and urethra. Sloughing of the urethra has destroyed five inches of its walls, with the adjacent corpus spongiosum. Behind the part which has sloughed, the canal of the urethra is lost in a large irregular cavity, like that of an abscess.

4. *Rupture of the urethra.*

There is no specimen of rupture of the urethra in the Museum.

5. *Impaction of a calculus behind the stricture.*

XXX. 11.—Section of a bladder and urethra. A disc-shaped calculus, seven-tenths of an inch in diameter, is fixed in the bulbous portion of the urethra immediately behind a slight stricture.

XXX. 39.—Part of a penis and prostate, with the urethra laid open. An inch in front of the membranous part of the urethra a stricture exists, through which the continuity of the canal cannot now be traced, but it appears to have been extremely narrow. The urethra posteriorly to the stricture is dilated, and immediately behind it a calculus, half an inch in diameter, is lodged in the most dilated part projecting towards the perinæum. The obstruction caused by the calculus, added to that of the stricture, appears to have completely closed the urethra. By the side of the stricture is a large cavity that was filled with foetid pus; it extends into the perinæum, where it is laid open by a long incision.

The patient was about forty-five years old, and had had stricture many years. Sudden retention of urine occurred, followed by rapid swelling and suppuration in the perinæum. An incision was made into the perinæum, and foetid pus let out, but the calculus was not felt, and the retention was only partially relieved.

B. *Changes in the bladder.*1. *Thickening of the mucous membrane and hypertrophy of the muscular coat.*

XXX. 15.—A bladder and urethra. An inch of the urethra immediately anterior to the bulb is closely contracted. The urethra behind the stricture is dilated. The muscular coat of the bladder is hypertrophied; it is half an inch in thickness, and its fasciculi project in strong columns or ridges on its inner wall.

This hypertrophy of the muscular coat is the result of the extra work which it has to perform in order to overcome the obstruction to the outflow of urine.

2. *Ulceration of the mucous membrane.*

XXX. 13.—A bladder and urethra. There is a stricture of the urethra immediately anterior to the bulb. The bladder is thickened and exceedingly contracted, and its mucous membrane, raised in projecting folds, is superficially ulcerated and nearly covered by calculous matter.

3. *Hernia of the mucous membrane.*

XXVII. 41.—A bladder and part of the urethra, laid open from the front. The muscular wall of the bladder is hypertrophied. Its mucous membrane is thick and coarsely rugous. On the right side, just above the orifice of the ureter, a narrow, funnel-shaped opening

leads to a large pouch, lined by a mucous membrane, but devoid of muscular tissue.

From the body of a man who had suffered from stricture of the urethra.

The protrusion of the mucous membrane between the muscular fibres was the result of the pressure upon the walls of the bladder in consequence of the obstruction to the expulsion of the urine.

c. Changes in the ureters.

1. Dilatation and hypertrophy of the muscular coat.

XXX. 8.—A lateral section of the bladder and urethra, exhibiting stricture of the urethra. One of the ureters is dilated into a small cyst at its termination.

XXX. 19.—The ureters in this specimen are dilated, and their muscular coat is hypertrophied.

2. Prolapse of the ureters ; rare.

XXVII. 46.—The bladder and a portion of the ureters from an old case of stricture of the urethra, with a history of two years' duration. The specimen shows the ordinary effects of urinary obstruction, as well as an unusual prolapsed condition of the vesical ends of both ureters, with extreme hypertrophy and dilatation of the tubes themselves; the vesical orifices of these tubes are reduced to mere pinhole apertures. The prolapsed pouch of the right ureter contains a calculus. There is a sacculus of mucous membrane thrust out between the muscular fibres of the posterior wall of the bladder. The prolapsus of the ureters seems to be due to the disproportion of size between the ureters themselves and their vesical orifices, as if, in the efforts to micturate, the urine being unable to escape freely from the bladder, the abdominal walls had compressed and borne down the ureters.

d. Changes in the kidneys.

1. Dilatation of the pelvis and infundibula ; absorption of the substance of the organ.

XXVI. 2.—A kidney, of which the pelvis and infundibula are dilated into a large sac. The greater part of the proper substance of the gland is absorbed; its remains form a thin layer covering over a portion of the sac.

XXVI. 3.—A kidney, exhibiting great dilatation and hypertrophy of the ureter, pelvis, and infundibula, with absorption of part of its substance.

INJURIES OCCASIONALLY SUSTAINED IN THE INSTRUMENTAL TREATMENT OF STRICTURE.

False passages.—XXX. 20. A penis, exhibiting a stricture of the urethra about an inch anterior to the bulb. The mucous membrane is thickened and indurated in the situation of the stricture, and the

canal behind it is much dilated. A bristle is introduced into the stricture, and another into a false passage formed by a catheter, which extends from the front of the stricture for a short distance along the outer side of the urethra.

XXX. 18.—A penis, with a portion of the bladder. About two inches from its external orifice the canal is contracted, forming a close annular stricture, behind which it is dilated in its whole length. From the stricture, a false passage, formed by catheters, is continued along the side of the urethra, in the corpus spongiosum, and through the prostate into the bladder.

CONGENITAL MALFORMATIONS OF THE PENIS.

EPISPADIAS AND HYPOSPADIAS.

Epispadias is a congenital malformation of the penis, in which the urethra opens upon the dorsal surface; or is exposed in its whole length through a median cleft along the dorsum of the penis. It is frequently associated with the congenital malformation of the bladder called extroversion or ectopia vesicæ.

Hypospadias is a congenital malformation in which the urethra opens upon the under surface of the penis, commonly but a short distance behind the glans, but it may be as far back as the root of the organ; in conjunction with this malformation the scrotum may be cleft.

There is no specimen of hypospadias in the Museum. One of epispadias follows.

A. 167.—The penis of an adult with epispadias. A median cleft along the dorsum of the penis extends into the urethra, from its orifice to the pubes. A loose fold of integument covered the fissure in its whole extent. The penis is short; but the other parts are well formed.

DISEASES OF THE LABIUM, CLITORIS, AND FEMALE URETHRA.

LABIAL CYSTS.

Labial cysts are probably mucous glands dilated in consequence of obstruction to the exit of their products. They frequently attain a considerable size, and have been found attached to the labium by a pedicle. They generally contain a mucoid, dark-coloured fluid, or in some instances a sebaceous material.

XXXII. 78.—A cyst, which was attached to the right labium by a slender pedicle.

HYPERTROPHY OF THE LABIUM.

XXXII. 36.—A nymphæ, removed from a middle-aged woman. It is enlarged so as to form a deeply lobed spheroidal mass, with a wrinkled and warty surface, between three and four inches in diameter. A section of it shows that it is composed of a firm, compact, and elastic tissue, like skin infiltrated with serous fluid.

TUMOURS OF THE LABIUM.

Fibro-cellular tumour (myxomata). XXXII. 80.—A large fibro-cellular tumour, which was attached by a broad pedicle to the left labium of a woman aged thirty-five. It had existed for ten years.

XXXV. 71.—A fibro-cellular (myxomatous?) tumour. Its presenting surface appears flocculent and soft from inflammation and sloughing. The tumour was flask-shaped and pendulous from the right wall of the vagina and right nymphæ.

The patient was thirty-four years old, and had noticed the disease for three or four years. It began as a tumour projecting into the vagina from beneath its external wall, and in this situation acquired a large size before it protruded externally. Its protrusion occurred ten days before its removal, and was followed by very quick enlargement, probably because of the inflammatory swelling. It was loosely connected with the surrounding tissues, and was easily removed. There was no return of the disease within two years and a half of the operation.

Fibrous tumours. XXXV. 19.—Section of a large fibrous tumour which formed within the labium pudendi. The tumour was removed from a lady twenty-eight years old. It had been observed four years; it had given no pain, and interrupted no function, though it was twice as large as an adult's head. It commenced its growth at the lower part of the left labium, and extended gradually along the buttock and over the os coccygis. It formed a pendulous mass rather broader than the two thighs.

The patient completely recovered. She remains well to this time, eighteen years after the second operation.

Melanotic sarcoma. XXXII. 62.—The labia and part of the vagina, removed by operation on account of a large mass of melanotic sarcoma, which, arising at the front part of the vagina, encroaches equally upon each labium.

CANCER OF THE LABIUM.

Cancer of the labium is usually of the epitheliomatous variety, and bears a general resemblance to the epithelial, or sweep's cancer of the scrotum.

XXXII. 42.—A labium, on the surface of which is an oval, elevated warty growth, of moderately firm texture, and with a finely granulated surface.

XXXII. 32.—The labia affected with cancer. They are both enlarged

and indurated. In the left labium, which is most diseased, the cancer forms an elevated, circumscribed, and superficially ulcerated swelling. They were removed from a middle-aged woman.

HYPERTROPHY OF THE CLITORIS.

XXXII. 54.—The prepuce of a clitoris, enlarged with a spheroidal mass between five and six inches in diameter. The mass appears composed of a compact and elastic fibro-cellular tissue. Its surface is lobed, fissured, coarsely warty, and brownish. It is suspended by the nymphæ, which were similarly, but slightly, enlarged.

The patient was twenty-six years old. The growth was removed four months after her first labour.

XXXII. 37.—A large mass, very deeply lobed, which was removed from a clitoris. It probably had its origin in enlargement of the preputium clitoridis.

VASCULAR GROWTHS IN THE FEMALE URETHRA.

Vascular growths are not infrequently found at the orifice of the female urethra; they are composed of villous tufts of the mucous membrane, containing loops of capillary blood-vessels and nerves. They are extremely sensitive, and bleed freely when touched.

XXXII. 28.—A vascular tumour, which was removed by ligature from the margin of the orifice of a woman's urethra.

DISEASES OF THE SCROTUM AND TESTICLE.

HYPERTROPHY OF THE SCROTUM.

Hypertrophy of the scrotum is common in persons who have long suffered from irreducible scrotal hernia or hydrocele. It must be distinguished from elephantiasis scroti, which is sometimes spoken of as hypertrophy.

XXVIII. 16.—A scrotum, whose tissues have undergone simple hypertrophy, probably due to the long continuance of a large hydrocele or hernia.

ELEPHANTIASIS SCROTI.

This term is applied to a chronic induration and thickening of the skin and cellular tissue of the scrotum. It seldom occurs in this country, but is common in tropical climates. The skin appears elevated in lobes and folds separated by deep fissures; the sebaceous glands are greatly enlarged, and exhibit wide, open orifices, surrounded by elevated rings; the cellular tissue is compact and fila-

mentous; the whole scrotum often attains a great size. The integuments of the penis are generally involved in the disease.

XXVIII. 18.—A scrotum affected by elephantiasis.

TUMOURS OF THE SCROTUM.

Various innocent tumours are occasionally found in connection with the tissues of the scrotum. Specimens of fatty and fibro-cellular (myxomatous) growths follow.

Fatty tumour XXVIII. 60.—A large fatty tumour removed from the back part of the scrotum. It has a lobulated outline, and the usual structure of the common fatty tumour or lipoma.

Fibro-cellular tumour (myxomata).—XXVIII. 75.—A fibro-cellular tumour (myxoma?), which was removed from the scrotum, with a portion of the integument.

XXXV. 70.—Part of a tumour from a scrotum, which weighed twenty-four pounds, and was about a foot in length. It is lobed, firm, elastic, white, and composed of compact, fibro-cellular tissue (P) In the recent state many parts of it were infiltrated with serum, making them quite succulent, and in some there were extravasations of blood. At the lower part of the mass, the testicle and its tunica vaginalis (which contained some ounces of serous fluid) are shown flattened by its pressure.

The patient was seventy-four years old, and the tumour was of five and a half years' growth. It was easily separable from the surrounding parts, into which many lobes extended far from its chief mass. It was complicated, not only with the hydrocele above mentioned, but with a large scrotal hernia that descended to its upper part, and with thickening and œdema of the scrotum.

The diagram No. 327 represents the tumour in its recent state.

CANCER OF THE SCROTUM.

Cancer of the scrotum is nearly always of the epithelial variety. It generally begins as one or more warty growths, consisting of several hypertrophied papillæ of the skin of the scrotum. The warts are usually of an oval shape, with a smooth and convex surface, slightly elevated, and projecting a little over the surface of the adjacent skin. After a time they become more vascular, superficially ulcerated, and covered with a scab formed by the encrusting of the discharge. The scab separates or is rubbed off, and there results an ulcer with sinuous, raised, everted edges and a warty base; the ulcer rapidly spreads, involving the whole skin of the scrotum, and the inguinal glands become affected.

From the great frequency with which it occurs in chimney-sweepers, cancer of the scrotum is generally designated the soot- or sweep's-

cancer. It appears to be due to the irritation caused by soot. The author has seen similar cases in operatives engaged in the manufacture of coal tar.

The following series of specimens illustrate the successive changes in the development of the cancer from the soot-wart.

A. The soot-wart.

XXVIII. 57.—Portion of a scrotum, on the surface of which is an elevated, oval, warty growth, of firm texture, with a slightly granular, smooth, convex surface, which was vascular but not ulcerated. The margins of the growth project a little over the surface of the adjacent skin. By the side of this growth is one of smaller size and superficially ulcerated.

From a young chimney-sweeper.

XXVIII. 77.—These horny growths were removed from the scrotum of a chimney-sweeper, where they had existed some months. During the last nine years five similar growths had formed, and had been shed after attaining a certain age. The base became surrounded by a ring of ulceration, and at length the least violence sufficed to detach them.

On the skin in the neighbourhood small, dark, warty growths were scattered. These had appeared in the last twenty years.

B. Increase in size and ulceration of the wart.

XXVIII. 58.—Portion of the scrotum of a chimney-sweeper. A large part of the surface is covered by a very elevated warty growth of firm, compact substance, the surface of which is nodular, deeply fissured and ulcerated.

C. Extension of the ulceration.

XXVIII. 59.—Portion of the scrotum of a chimney-sweeper, in which, by the further progress of the disease as presented in the three preceding specimens, there is a deep ulcer with thickened sinuous margins. Along one margin of the ulcer there are several small warty growths like that in No. 57, and superficially ulcerated.

D. The fully developed cancer.

XXVIII. 61.—Portions of skin affected with soot cancer; the larger portion from the scrotum; the smaller from the perinæum. On the latter are two small cancerous warts, one prominent and branched, the other nearly subcutaneous. On the former the cancerous disease appears partly in deep ulceration, partly in the form of large warty growths. The margins of the ulcer, shown especially on the right side, are, for the most part, sinuous, raised, and everted; its base appears coarsely warty. The chief warty growth is at the lower part of the specimen. Its surface is nodular and fissured, and from many parts of it there arise conical, curved, sharp-pointed bodies, about one third of an inch in length, firm and white, like the strong papillæ of a carnivore's tongue. The cancerous structures extend to a depth of from one-eighth to one-fourth of an inch. Their microscopic constituents are those of epithelial cancer.

The patient was a healthy-looking chimney-sweeper, twenty-five years old. He had observed one of the small warts in the perinæum for four years. The disease in the scrotum had existed only one year, and its progress was so rapid, both by ulceration and by subcutaneous extension, that it was necessary to remove all the skin of the scrotum, except a small piece at its lower part, a portion of the skin of the perinæum, the prepuce and all the skin of the penis, except a narrow ring round its middle, and nearly all the skin of the mons veneris. The right testicle also, to which the base of the ulcer adhered, was removed, and three enlarged inguinal glands. The patient recovered easily from the operation, and the wounds were healed in three months.

OSSEOUS GROWTH FROM THE SCROTUM.

XXVIII. 74.—Osseous growth removed from the scrotum. From the history of the case it was believed to have originated from an epithelial wart.

HYDROCELE.

Hydrocele is a collection of fluid in connection with the testicle or spermatic cord. (Hydrocele of the spermatic cord will be found under the head of Diseases of the Spermatic Cord.) Two varieties of hydrocele in connection with the testicle are described, the ordinary or vaginal hydrocele, and the so-called encysted hydrocele.

ORDINARY OR VAGINAL HYDROCELE.

Ordinary hydrocele is a collection of serous fluid in the cavity of the tunica vaginalis.

The fluid is generally transparent and of a pale straw colour; it has a specific gravity of 1030, contains albumen, and is coagulable by heat. Occasionally, however, it is thick and dark coloured, owing to the presence of altered blood, and in old people it may contain shining crystals of cholesterine.

Ordinary hydrocele fluid. XXVIII. 73.—A clear, straw-coloured fluid, from a hydrocele of the tunica vaginalis.

The sac, formed by the distended tunica vaginalis, is generally pear-shaped, with the narrow end upwards; or it may be oval, in which case there is often a slight transverse constriction at its upper or lower part due to the unequal yielding of its walls, to the presence of bands of adhesions, or, in the case of large hydroceles, where the fluid has encroached upon the funicular portion of the tunica vaginalis, to the narrowing which naturally exists between the tunica vaginalis and its funicular portion.

Pear-shaped.—XXVIII. 6.—A hydrocele. The sac is somewhat pear-shaped.

Oval, with transverse constriction.—XXVIII. 5.—The tunica vaginalis and spermatic vessels from a case of hydrocele. In consequence of an unequal yielding of the tunica vaginalis, there is a distinct prominence of the swelling at its lower part.

The walls of the sac are commonly thin and transparent, but in old-standing cases they become greatly thickened and sometimes cartilaginous or even bony.

Ordinary condition of the walls.—XXVIII. 5.—A hydrocele. The walls are thin and transparent.

Thickening of the walls.—XXVIII. 7.—A hydrocele, with thickening of the enlarged tunica vaginalis and opacity of its internal surface.

XXVIII. 23.—A hydrocele, with thickening of the tunica vaginalis, and an irregular nodulated and tuberculated condition of its internal surface.

XXVIII. 9.—A tunica vaginalis greatly enlarged and thickened; its walls are from one to three lines in thickness, tough and laminated; its internal surface is granulated and very vascular; and its cavity was filled with pus.

Cartilaginous thickening of the walls.—XXVIII. 2.—A hydrocele, in which the enlarged tunica vaginalis is thickened and indurated, so that it is like cartilage in texture.

The testicle is usually situated behind and a little below the centre of the sac; but it may be found in front, either from having descended with the epididymis transposed, or from having contracted adhesions to the anterior wall; this latter condition gives the hydrocele a sacculated appearance.

The testicle is generally somewhat flattened, but seldom atrophied. The constituents of the cord are spread out over the back of the sac, and the cremaster muscle is hypertrophied and well marked.

The testicle behind the sac.—XXVIII. 2.—A hydrocele of the tunica vaginalis; the testicle is situated at the middle of the posterior wall of the sac. The testicle itself is healthy.

XXVIII. 6.—A hydrocele. The blood-vessels of the tunica vaginalis and testicle are injected. The testicle is divided, and appears healthy.

CONGENITAL HYDROCELE.

When, as frequently happens, a hydrocele forms in the sac of the tunica vaginalis, the funicular portion of which has not been obliterated, a free communication necessarily exists between the interior of the hydrocele and the general peritoneal cavity. This variety is called congenital.

Rarer conditions of Vaginal Hydrocele.

Division of the sac by an incomplete membranous septum.—XXVIII. 8.—A very large hydrocele, with thickening of the tunica vaginalis. The testicle is situated near the middle of the posterior wall of the sac, and a thick and broad membranous partition extends from it transversely across the middle of the sac, which it separates into two cavities communicating only in front of the partition. The vas deferens is exposed running vertically along the back part of the tumour.

Adhesions between the layers of the tunica vaginalis.—XXVIII. 52.—Two testicles. Upon the upper part of each there is a cyst of globular form, which was filled by a watery fluid. It is probable that this cyst was formed between the layers of the tunica vaginalis, which in the rest of their extent are adherent. The structure of the testicles themselves is healthy.

ENCYSTED HYDROCELE OF THE TESTICLE.

The so-called encysted hydrocele of the testicle is a collection of fluid in one or more cysts which have no communication with the cavity of the tunica vaginalis.

The cysts may occur either between the tunica vaginalis and the tunica albuginea, or in connection with the epididymis. In the former situation encysted hydroceles are rare; they consist of single thick-walled cysts containing a brownish-green fluid, developed in front of the testicle in the connective tissue between the above-mentioned tunics.

Those in connection with the epididymis are more common, and are composed of one or several cysts filled with watery fluid which often contains an abundance of spermatozoa; their walls are thin and membranous, and lined with tessellated epithelium. If carefully examined they are generally found to communicate with the ducts of the epididymis. Their true origin is still doubtful, the general opinion being that they are developed from some of the foetal remains (Wolffian body, Müllerian duct), so abundant in the situation of the epididymis.

XXVIII. 41.—A hydrocele of the testicle, consisting of a single cyst immediately above the testicle.

XXVIII. 43.—A testicle, with part of the spermatic cord. Along the epididymis there is a series of thin and delicate membranous cysts communicating together, and having for their boundary the tunica vaginalis at its reflection between the testicle and epididymis. They contained a transparent and colourless fluid. A bristle is passed beneath the vas deferens near its connection with the epididymis.

Fluid from an encysted hydrocele.—XXVIII. 72.—Slightly opalescent fluid, containing an abundance of spermatozoa, from an encysted hydrocele of the testis.

Compare this with the specimen of fluid from an ordinary hydrocele, XXVIII. 73.

HÆMATOCELE.

A hæmatocele is an effusion of blood into the cavity of the tunica vaginalis, or into a cyst connected with the testicle or spermatic cord. The former of these conditions, being by far the most common, is that which is usually understood by the term hæmatocele. For the sake of distinction, however, it will be here spoken of as common hæmatocele, and the two rarer forms will be spoken of as encysted hæmatocele of the testis and cord respectively.

Common hæmatocele is generally the result of a blow or kick on the testicle; it may also occur from similar injuries to a hydrocele, or it may follow the operation of tapping a hydrocele; either in consequence of the puncture of a vessel or of the testicle itself, or in consequence of the sudden reduction of pressure in the blood-vessels of the tunica vaginalis by the withdrawal of the fluid. The blood may under favourable circumstances be absorbed leaving the tunica vaginalis healthy. More commonly, however, secondary changes occur both in the sac and its contents. The walls become inflamed and thickened, and the blood coagulates in the interior of the sac and adheres to the roughened surface of the walls, so that the hæmatocele when cut open has somewhat of the laminated appearance of an aneurism. The centre of the clot may break down into a chocolate-coloured fluid, which, under the microscope, is seen to consist of broken-down blood-corpuscles, hæmatine, and cholesterine crystals. Suppuration is also liable to occur, and the hæmatocele may thus become an abscess.

The source of the blood is doubtful. It has been attributed to the rupture of some of the large veins on the surface of the testicle or external to the parietal layers of the tunica vaginalis. In a few cases it has been traced to a wound of the spermatic artery.

Encysted hæmatocele of the testis is exceedingly rare. It is the result of injury to an encysted hydrocele, and undergoes changes similar to those described under common hæmatocele.

Encysted hæmatocele of the cord will be found described under affections of the spermatic cord (see p. 387).

XXVIII. 4.—A testicle, with the cavity of the tunica vaginalis, enlarged and filled with masses of soft fibrinous substance from coagulated blood. The tunica vaginalis is thick and hard; the testicle is healthy.

XXVIII. 44.—A testicle and tunica vaginalis; the tunica vaginalis laid open by a section carried through the testicle from behind, is thickened and enlarged. Its cavity was filled with fluid blood, and

irregular masses of solid blood-stained fibrous substance adhere to its internal surface. The testicle appears healthy.

XXVIII. 88.—Testicle and tunica vaginalis divided and laid open. The tunica vaginalis, which had probably been the seat of an old hæmatocele, was found filled with pus. Its walls are dense and thickened by layers of fibrous tissue, which in one place presents the appearance of fibro-cartilage. The testicle appears normal.

The specimen was taken from the body of an old man, who died of senile gangrene of the leg, with bronchitis. He had complained of pain in the testicle only a few days before death.

DISEASES OF THE TESTICLE.

ACUTE INFLAMMATION.

Acute inflammation is spoken of as orchitis or epididymitis, according as it begins in or affects chiefly the body of the testicle or the epididymis.

Inflammation of the body is usually the result of injury, such as a blow, kick, or squeeze of the testicle; also of metastasis, as in mumps.

Inflammation of the epididymis, which is far more common, is generally caused by the extension of inflammation from the urethra (consequent upon gonorrhœa, impacted calculus, or the passage of instruments) along the vas deferens to the epididymis.

The body or the epididymis, according as the disease begins in the one or the other, appears tense and swelled. On section the intertubular connective tissue is seen injected and infiltrated with inflammatory material and the tubules filled with mucoid and purulent fluid. The tunica vaginalis is distended with a small quantity of turbid inflammatory effusion (acute hydrocele): a condition, however, more frequently observed in epididymitis than in orchitis. The inflammation in the majority of cases terminates in resolution, leaving the testicle little if at all functionally deteriorated. At other times it may pass into the chronic condition, or again, when very acute, it may end in suppuration and abscess.

XXVIII. 55.—A testicle, exhibiting the effects of acute inflammation in its interior. Several irregular cavities extend through the interior of the testicle, which were filled by pus and inflammatory material. The pus has escaped, but portions of the inflammatory material remain. The glandular tissue around these cavities is consolidated. A small quantity of transparent fluid was found in the sac of the tunica vaginalis, and there were partial adhesions between its opposite surfaces. At one part the tunica albuginea is thin and irregular on its surface, as if yielding to the enlargement of the testicle.

From a man in whom the operation of lithotripsy had been performed. The disease of the testicle commenced a week after the operation, and nearly a week before the patient's death. A portion of the broken calculus had previously become fixed in the urethra. The bladder, XXVII. 30. was taken from the same patient.

XXVIII. 34.—A testicle, enlarged and indurated, with small circumscribed abscesses in its interior.

CHRONIC INFLAMMATION.

Chronic inflammation of the testicle may be a sequel to the acute disease, or it may begin as a chronic affection, when it is generally the result of slight injury in a debilitated, gouty, or rheumatic subject. As a sequel to the acute, the disease may affect either the body or the epididymis, according as one or other of these parts was the seat of the primary inflammation. When the disease occurs in the body the inflammatory material, infiltrating the intertubular connective tissue, may either become absorbed, leaving the testicle little if at all functionally deteriorated, or it may undergo a fibroid change, and, like all newly-formed fibrous tissue, contract, pressing upon and obliterating the tubules, and finally converting the affected part into a mass of fibrous tissue. When the disease is confined to the epididymis, should absorption not take place, the ducts of this organ are pressed upon and obliterated by the contraction of the inflammatory material in a similar manner, and the epididymis appears as a small nodular mass of fibrous tissue. From the inability of the secretion of the testicle to escape through the obliterated ducts, the tubuli seminiferi become dilated and subsequently more or less destroyed by the pressure of the retained secretion, and atrophy of the testicle sometimes, but not invariably, follows.

When the disease is chronic from its commencement, it generally begins in the body of the testicle, occasionally, though rarely, in the epididymis, and then more often in the lower part or "tail" than in the "head" (Curling). As the disease progresses all distinction between the body and the epididymis is lost, the testicle appearing enlarged, smooth, and indurated, and on section infiltrated with distinct yellowish-white masses of cheesy-looking material somewhat resembling tubercle. The tunica vaginalis is usually adherent and thickened. On microscopical examination both the tubules themselves and the intertubular connective-tissue appear infiltrated with inflammatory material.

It is generally believed that the inflammation begins outside the tubules, and that the inflammatory products within are merely the result of the external irritation.

The inflammatory material may become completely absorbed, or it may undergo a fibroid change like that already described as following the acute form of inflammation, or the tunica albuginea, together with the adherent tunica vaginalis and skin, may give way, and the inflammatory material and what remains of the tubular structure of the testicle may protrude as a fungating mass covered with granulations. This benign protrusion, sometimes called *hernia testis*, may be distinguished from a malignant fungus by the healthy, non-adherent condition of the skin around, by the absence of blood coagula on its surface, and by the absence of other signs of cancerous disease.

Inflammatory Infiltration.—XXVIII. 66.—A testicle and its membranes divided by a longitudinal section. The testicle which is seen above was easily turned out from its membranes. Its structure appears to be but slightly altered, beyond being infiltrated with inflammatory products. The membranes are altogether much thickened and otherwise altered, apparently the result of chronic inflammation.

From a man aged thirty-one. The disease has existed about five months.

Induration and Abscess.—XXVIII. 45.—A testicle and spermatic cord. In the centre of the testicle there is an irregular circumscribed abscess, from which a fistulous track (into which a portion of glass is introduced) extends through the tunics of the testicle and scrotum. The substance of the testicle around the abscess is indurated.

“*Hernia testis.*”—XXVIII. 27.—A testicle with a portion of the scrotum. The testicle, covered on its anterior part by a layer of granulations, is protruded through an ulcerated aperture in its tunics and in the scrotum. A section of the protruded testicle shows that its glandular tissue is but little altered; but the epididymis appears indurated and consolidated with the adjacent tissues.

XXVIII. 29.—Portion of a testicle covered with granulations, which was protruded through an ulcerated aperture in its tunics and the scrotum.

XXVIII. 56.—Sections of a testicle, with the cavity of the tunica vaginalis obliterated by layers of false membrane a third of an inch in thickness, and very tough and compact. At the posterior part, by the side of the epididymis, earthy matter has been deposited in the midst of the new tissue. The substance of the testicle is soft, but not otherwise diseased; it is of natural size, but the epididymis is enlarged and indurated. All the tissues around the tunica vaginalis appeared thickened, adherent, and hard, and, together with the thick layer of false membrane, gave the characters of a considerable enlargement of the testicle itself.

The other testicle was similarly but less diseased.

Fibroid degeneration.—XXVIII. 80.—A testicle removed from a man, aged fifty-two. It had been enlarged for nine years. The bulk of its substance has disappeared, its place being supplied by a dense firm

though friable mass of fibrous tissue. The tunica vaginalis has been converted into a thick-walled cyst, the interior of which was covered with lymph and apparently old blood clots. Above the main was a smaller though similar cyst.

TUBERCULAR DISEASE OF THE TESTICLE.

Tubercular or strumous disease of the testicle is characterized by the presence of yellowish white masses of tubercular-looking material in the body and epididymis. It generally affects first the epididymis and in some instances may remain entirely confined to it. Usually, however, the body of the testis becomes subsequently involved. The vas deferens and vesiculæ seminales are also frequently found infiltrated with tubercle; indeed, the local affection of the testicle is often but a part of a general tuberculosis of the genito-urinary tract.

Tuberculous disease may begin within the tubules as a chronic catarrhal inflammation, the products of which afterwards undergo caseous changes; or without the tubules as a deposit of true miliary tubercles in the lymphatic tissue, especially in the neighbourhood of the rete testis. These miliary tubercles afterwards become caseous and indistinguishable from the caseous masses resulting from the degeneration of the inflammatory products formed within the tubules.

A tuberculous testicle is enlarged and nodular, and the epididymis forms a distinct prominence at its upper and posterior part. On section circumscribed masses of yellowish, caseous-looking material are found scattered throughout the tubular structure, or even occupying the whole interior of the organ.

If the disease is not arrested, ulceration of the skin and of the tunics of the testicle takes place, allowing the morbid substance, along with what remains of the proper tissue of the testicle, to protrude through the skin of the scrotum; the fungus thus protruded is covered with granulations and a purulent discharge. In other instances the tuberculous matter, together with much of the gland-substance, breaks down and is discharged through the ulcerated aperture in the scrotum, leaving unhealthy fistulous tracts in the substance of the testicle; or, again, the caseous material may dry up and undergo calcification. Under the use of appropriate remedies what remains of the secreting structure, both within the tunics and even in the fungating mass, may be restored and regain their functional activity.

Tubercle of the testicle, although a disease of early life, is uncommon before puberty.

The epididymis chiefly affected. XXVIII. 33.—A testicle, exhibiting

distinct and circumscribed deposits of tuberculous matter in the epididymis. The vas deferens is obliterated and contracted. The body of the testicle appears healthy.

Affecting epididymis and body.—XXVIII. 38.—Two testicles enlarged, and having circumscribed deposits of tuberculous matter in their interior and in that of each epididymis.

XXVIII. 67.—The left testicle removed from a man aged forty. It is divided by a longitudinal section. The whole interior is filled by a deposit of caseous tubercle; scarcely a trace of the natural structure of the testis is visible. The testis had been enlarged for eight months. The right epididymis was also considerably increased in size.

Affecting both testicles. XXVIII. 22.—A testicle, exhibiting a circumscribed mass of tuberculous substance in its centre. The adjacent part of the testicle appears healthy, and the morbid deposit has produced no enlargement. The other testicle was similarly diseased.

XXVIII. 79.—Tuberculous disease of the testis, from a man aged forty, who died of phthisis. The other testis was similarly diseased. He first noticed an enlargement of this testicle eight months before death, and six months afterwards the other testis became affected.

General tubercular condition of the genito-urinary tract. XXVIII. 32.—Two testicles. One of them is enlarged to twice its natural size by pale yellow and soft tuberculous matter, which is almost uniformly diffused through its substance, leaving scarcely any intervening portions of the glandular tissue. In the other testicle are several distinct and circumscribed deposits of tuberculous matter at its lower part, and in the epididymis.

From a man thirty years old. The enlargement of the testicle first described had been observed many years. He died with tuberculous disease of the prostate, lungs, and other organs.

XXVIII. 20.—Sections of a testicle enlarged, indurated, and in many parts infiltrated with tuberculous matter. The part which is not filled with tuberculous matter is white and tough, like the tissue of a cicatrix. The tuberculous matter is in circumscribed masses of irregular shape, compact, and of a pale yellowish-white colour, which project above the surface of the substance in which they are deposited. Above the testicle there is a mass of similarly indurated tissue with tuberculous deposit, situated either in the spermatic cord or in the upper part of the epididymis.

The patient was a gentleman forty-two years old. The testicle had been enlarging for seven years. Shortly before its removal the disease appeared to extend rapidly up the spermatic cord, and some enlargement was observed in the opposite epididymis.

Fungating protrusion through the scrotum. XXVIII. 35.—A testicle with a portion of the scrotum. The testicle enlarged and indurated, and exhibiting appearances of tuberculous matter deposited in it, is protruded through an ulcerated aperture in its tunics and the scrotum. Its protruded surface is thinly covered with granulations; its posterior part appears healthy.

XXVIII. 50.—Section of two testicles. Of one testicle the place of the natural structure is entirely occupied by large masses of tuberculous substance. Of the other testicle, a small portion of the natural structure remains around a mass of tuberculous substance. Ulceration of the skin and of the tunics of one testicle had taken place, allowing the protrusion of the morbid substance to the outside of the scrotum. Both testicles were removed at the same time from a man forty years old.

SYPHILITIC DISEASE.

The testicle may be affected both in the early and the later stages of syphilis.

In its early (the so-called secondary) *stages* syphilis attacks the testicle in the form of a chronic inflammation of the intertubular connective tissue. Under appropriate treatment the inflammatory material may undergo complete absorption, leaving the organ apparently healthy. Otherwise it is apt to degenerate into fibrous tissue, which, by its subsequent contraction, destroys the tubules, and therefore leads to atrophy of the testicle. The body of the testicle, to which the disease is usually confined, is slightly enlarged, hard, heavy, smooth, egg-shaped, and flattened laterally, and on section the intertubular connective tissue appears uniformly infiltrated by a dense, tough, yellowish-white material. These appearances are occasionally obscured by the presence of a small hydrocele of the tunica vaginalis. Suppuration seldom ensues. Usually one testicle only is affected.

In its later (the so-called tertiary) *stages* syphilis attacks the testicle in the form of distinct gummous growths situated in the connective tissue between the tubules, producing an irregular uneven enlargement of the body of the testicle. The gummous growths, although they may yield to treatment and become absorbed, frequently soften and suppurate, the tunics and skin ulcerate, and there result fistulous passages in the body of the testicle. In rare instances a fungus may protrude through the ulcerated aperture in the tunics and skin. Both testicles are frequently affected.

XXVIII. 81.—Sections of a testicle. The organ is but little altered either in shape or size. Its external surface is uniformly smooth, firm, and inelastic to the touch. The epididymis is scarcely if at all affected. The glandular structure of the body of the testicle has been completely replaced by a dense, tough, yellowish-white material, like old inflammatory lymph. This under the microscope is seen to consist of fine granules and of oil globules of various sizes, with no trace of fibrillation, and only faint vestiges here and there of cell formation.

The specimen was taken from the body of a middle-aged man brought

to the hospital for dissection. No history of the case could be obtained, but numerous scars like those the result of syphilitic ulceration were seen on various parts. The companion testis was similarly affected, but to a somewhat less extent.

CARCINOMA OF THE TESTICLE.

Carcinoma of the testicle is a common affection. It is nearly always of the medullary type; scirrhus, however, sometimes, though rarely, occurs. Medullary cancer generally begins in the body of the organ in the form of one or more distinct nodules; more rarely as a general infiltration. The tubular structure of the gland is encroached upon and destroyed by the advancing disease, or merely, as when the cancer begins in the rete testis, dispersed and spread over and around the growth. The epididymis, in the early stages unaffected, later becomes invaded and rendered indistinguishable from the rest of the gland.

The tunica albuginea becomes thickened and the tunica vaginalis inflamed by the irritation of the new growth, and the cavity of the latter either distended by a small quantity of inflammatory effusion or obliterated by the adhesion of the visceral to the parietal layers.

The skin then becomes adherent and ulcerates, and a fungating mass of cancer protrudes; the cancer likewise spreads up the lymphatics of the cord to the lumbar glands, and is thence deposited in various organs of the body.

A testicle affected with medullary cancer enlarges with great rapidity, and often attains a large size; it is at first smooth, afterwards nodular, tense, yet elastic, and semi-fluctuating in places, and of a globular or pyriform shape; the epididymis is indistinguishable from the rest of the gland. On section it is seen to consist of yellowish-white brain-like material, intersected by numerous fibrous septa, the remains of the trabeculae and of the mediastinum testis. The surface of the section is frequently blotched by patches of red, due to extravasation of blood from rupture of the capillary vessels, and here and there by patches of yellow, the result of fatty degeneration of the cancer elements; masses of cartilage and cysts occur in some specimens. The cord is infiltrated with similar growths of cancer, and its vessels are enlarged. The skin of the scrotum is traversed by large tortuous veins; it is not at first adherent to the testicle, but afterwards becomes so, and finally ulcerates, allowing the cancerous fungus to protrude. After the skin is involved in the disease the inguinal glands, which receive the lymphatics from the superficial part of the scrotum, become affected as well as the lumbar glands, which receive those of the

testicle. The cancerous fungus is characterized by its sloughy, blood-stained surface, its sanious foul-smelling discharge, and by the adherent and infiltrated condition of the skin around.

XXVIII. 12.—A testicle, of which the natural structure cannot be discerned, its place being occupied by a large oval mass of soft medullary cancer traversed by partitions which divide it into many round masses. The tunica albuginea is thickened, and the opposite surfaces of the tunica vaginalis are adherent.

XXVIII. 31.—Section of a testicle, in which the place of the natural structure is filled by a large oval mass of soft, and apparently very vascular, medullary substance, like that in 12. The morbid growth extends from the upper part of the testicle into the cellular tissue of the spermatic cord. The opposite surfaces of the tunica vaginalis are adherent.

XXVIII. 42.—Sections of a testicle and of a large medullary growth connected with it. In one part of the preparation the section of the testicle exhibits its internal structure unaltered; and in this situation the morbid growth appears to spring from the tunica albuginea. The vas deferens is traced to the testicle.

XXVIII. 15.—A similar specimen to 12, but the medullary substance is firmer and more uniform, and a portion of it has protruded through a large ulcerated opening in the coverings of the testicle and in the scrotum. The protruded portion is softer than the rest, and blood is diffused through it. The surface of the protrusion is smooth.

XXVIII. 62.—Sections of a testicle, the natural structures of which are put out of sight by the growth of a large mass of medullary cancer, around which they are, probably, with the tunica albuginea, extended. The cancerous substance is lobed, pale, soft, and greyish. Embedded in its lower part, and separated from it by a thin filamentous capsule, is an oval mass of cartilage, from an inch and a half to two inches in diameter. Points of bone are scattered in the cartilage; and its apparent construction of cylindriform, tortuous pieces, indicates the probability that it was formed in tubes, which, by the growths in them, have been lengthened and made tortuous, and clustered into one mass.

The patient was thirty-eight years old.

XXVIII. 83.—A testicle, removed after death, from a man aged forty-five. The lower part is occupied by a dense and hard, mostly well-defined mass, presenting both to the naked eye and under the microscope the appearance of cartilage. The upper portion of the testicle exhibits the usual appearance of medullary cancer.

There were numerous secondary deposits in various parts of the body, with little or none of the cartilaginous element whatever in them.

SARCOMA.

Sarcomata of the testicle are indistinguishable except by their microscopical characters from medullary cancer, with which disease they were formerly confounded. They are commonly of

the round-celled variety, and like medullary cancer are associated with the formation of cysts, and often contain masses of cartilage scattered through their substance.

XXVIII. 85.—Sarcoma of the testicle, containing a large quantity of cartilage.

CARTILAGINOUS TUMOURS.

Cartilaginous tumours of the testicle must be distinguished from the secondary growths of cartilage so frequently occurring in sarcomatous, carcinomatous, and cystic disease of the testicle. Primary cartilaginous tumours generally involve the whole organ, which they render exceedingly firm and hard, so that when handled they give the sensation of bone to the touch. On section they are seen to consist of tortuous, cylindrical, and knotted pieces of cartilage closely packed and embedded in a tough fibrous tissue. The tubules are in general completely involved in the mass of cartilage, but some of them are occasionally pressed aside by the growth and spread out, unaltered in structure, between it and the tunica albuginea.

The character of the cartilage varies with the rate of growth. When the growth is rapid the cartilage partakes of the hyaline form, when less so it partakes of the fibrous. It is liable to undergo ossification. The cartilage usually has its origin in the tubes, sometimes, as in Sir James Paget's case (XXVIII. 68), in dilated lymphatics.

The disease may secondarily affect distant organs.

XXVIII. 68.—Section of a cartilaginous tumour, from a man aged thirty-seven.

XXVIII. 69.—A branching cartilaginous growth, which projected from a lymphatic into the cavity of the vena cava inferior. The coats of the vein, which had undergone no change in their structure, were reflected on its narrow base, but, gradually thinning, were lost on many of its branches, which thus appeared bare and in direct contact with venous blood.

XXVIII. 70.—A large lymphatic laid open. Its canal appeared filled by a cylindrical growth, but this could be loosened and unravelled into the bundle of variously shaped small bodies suspended on long branching stems, and consisting usually of nodules of cartilage embedded in a softer tissue.

XXVII. 71.—A cluster of small oval and rounded swellings, which extended along the course of the spermatic cord, and were loosely connected with its structure. They are composed chiefly of small cylindrical and nodular pieces of cartilage clustered with growths of a softer substance on slender threads, and enclosed in thin-walled canals.

XXVIII. 84.—Cartilaginous tumour of the testicle.

FIBROUS TUMOURS.

Fibrous tumours of the testicle are rare. They generally appear as hard, firm, encapsulated growths, having the ordinary microscopic characters of the fibromata. They spring from the intertubular connective tissue, and as they increase in size displace and spread out the tubular substance around them. They are innocent growths.

XXVIII. 54.—Sections of a testicle. A firm, apparently fibrous, tumour has been formed in the interior of the testicle. The remains of the glandular substance, unaltered in structure, are expanded around the tumour, between it and the tunica albuginea. Bristles indicate the line of division between them.

Removed from a man twenty-five years old.

XXXV. 73.—Section of a tumour which has grown within the tunica albuginea of the testicle. It is of nearly regular, oval shape, and about six inches in its chief diameter; it is lobed, and now close-textured, pure white, like a lump of firm connective tissue. In the recent state it was succulent and translucent, its substance being infiltrated with a clear, yellow, serous and synovia-like fluid. Part of the tunica albuginea is reflected from its surface, and within this part seminal tubes are found spread out around it.

The patient was thirty years old, and the growth of the tumour was observed for seven years. In microscopic structure it showed scarcely anything but fibro-cellular tissue, in bundles of well-formed filaments mingled with elongated fibre-cells. A diagram (326) shows the tumour in its recent state.

CYSTIC DISEASE.

Two forms of cystic disease of the testicle are commonly described, the malignant and non-malignant. The malignant appears to be merely a cystic degeneration of cancerous or sarcomatous growths, of which mention has already been made. The non-malignant form or the true cystic disease consists of a collection of multilocular and proliferating cysts, bound together by fibro-myxomatous tissue, in the body of the testicle. The cysts appear to be formed by the dilatation of the ducts of the rete testis, and may occupy nearly the whole of the organ, displacing the tubuli seminiferi, which but little altered in structure, are commonly spread out over them. The ducts of the epididymis are at first unaffected, but afterwards become atrophied. The cysts, which may be few or many, vary in size from microscopical minuteness to half an inch or more in diameter, and are lined with tessellated epithelium like that lining the tubes of the rete testis. They generally contain a serous or mucoid fluid, frequently tinged with blood. When

large they may also contain growths springing from their walls, and composed of epithelial-like cells. Sometimes little masses of cartilage are found filling the cysts. The fibrous tissue surrounding the cysts is probably, in great part, intertubular connective tissue hypertrophied from irritation. A testicle affected with cystic disease is generally of large size, smooth, uniform, semifluctuating in places, non-translucent, and of a pyriform or globular shape. The vessels of the cord are frequently enlarged and varicose.

XXVIII. 24.—A testicle, in which there is a large firm tumour, in parts appearing fibrous, in parts spongy, and having numerous cysts with distinct membranous walls embedded in its substance. In some of the larger cysts there are growths of soft substance. The opposite surfaces of the tunica vaginalis are partially adherent.

XXVIII. 51.—A testicle, removed by operation. Its interior is occupied by a tumour developed among the tubuli seminiferi, and still surrounded by a thin layer of them. The lower part of the tumour is formed by a homogeneous compact yellow substance; but its chief mass is composed of a firm tissue, traversed by white fibres, in which there are numerous cysts. The walls of the cysts are closely connected with the surrounding tissue, and they are lined by a polished membrane. Most of them were filled by a fluid resembling mucus; others contained a fluid like serum; and in one, a small lobulated growth has arisen from the interior of the wall, and nearly fills the cavity.

From a gentleman of middle age, in whom the tumour had grown slowly. Four years after the operation he was in perfect health.

ATROPHY.

Atrophy of the testicle may be simply the result of old age; or it may be induced by pressure, by interference with the blood supply of the testicle, or by disease of the testicle itself. A non-descended testicle is frequently atrophied, especially when retained in the inguinal canal, where it is subject to pressure by the action of the abdominal muscles or by the use of a truss.

In atrophy from old age, from pressure, or from interference with the blood supply, the testicle becomes smaller, softer, and loses its elasticity, but it retains its shape, except in the case of atrophy from pressure when it is slightly flattened. The tubules are wasted, indistinct, and contain no spermatozoa. The epididymis is reduced to a few fibrous threads, and the constituents of the cord are shrunken and wasted. The atrophy is generally accompanied by fatty degeneration.

In atrophy from disease the testicle not only decreases in size, but also loses its shape, becoming irregular, nodular, and uneven.

The tunica vaginalis is adherent and the whole organ is converted into a mass of firm fibrous tissue.

From pressure. XXVIII. 25.—A testicle, reduced to half its natural size, in consequence of the pressure of a hydrocele in the opposite side of the scrotum. The body of the testicle is much more atrophied than the epididymis.

From old age. XXVIII. 26.—The atrophied testicle of an old man.

DISEASES OF THE UNDESCENDED TESTICLE.

Atrophy and medullary cancer are the principal affections of the non-descended testicle. Two specimens of medullary cancer follow.

XXVIII. 40.—A testicle, with a portion of the abdominal walls. The place of the testicle is occupied by a medullary cancer. The tunica vaginalis communicated with the cavity of the abdomen.

The liver and mesenteric glands were secondarily affected by the cancer. See XVI. 5 and XVIII. 6.

XXVIII. 78.—Encephaloid cancer of the left testicle, which had only descended through the inguinal canal, not reaching the scrotum. In the operation for its removal, the diseased testicle was found lying immediately beneath the integuments and outside the aponeurosis of the external oblique muscle. The right testicle was healthy and in the proper situation.

From a man, aged twenty-five.

UNDEVELOPED TESTICLE.

XXVIII. 76.—The right testicle, undeveloped, of a man, aged twenty-two, who during his life was of a feeble intellect, and subject to epileptic fits.

DISEASE OF THE SPERMATIC CORD.

HYDROCELE.

Hydrocele of the cord may be either diffused or encysted.

Diffused hydrocele is simply a dropsy of the cellular spaces of the cord. As it is very rare, and as there is no specimen of it in the Museum, it will not receive further notice.

Encysted hydrocele of the cord is a collection of fluid in a cyst or cysts in connection with the spermatic cord. The cysts are generally formed of portions of the funicular process of the tunica vaginalis, which have remained unobliterated and have become distended with serous fluid.

The cyst, or cysts, when there are more than one, are frequently found connected with the peritoneum above and with the tunica vaginalis below by a white, shining, fibrous cord, the remains of the obliterated funicular process.

Although the cysts are commonly produced in the manner above described, it is probable that they may be occasionally developed from some of the foetal remains, so abundant in the neighbourhood of the epididymis and at the commencement of the cord, *e.g.* the organ of Giraldès or the hydatid of Morgagni.

The walls of the cyst are generally thin and membranous and lined with squamous epithelium, but they may be found thickened and granular on their internal surface as the result of irritation or inflammation. They usually contain a clear, transparent, straw-coloured fluid, like that of ordinary hydrocele; but in rare instances a watery fluid containing spermatozoa and resembling that of encysted hydrocele of the testis, hence it is probable that in these instances the cysts are developed from foetal remains. The fluid, like the walls, may undergo secondary changes and become dark and turbid.

The coverings of an encysted hydrocele are the same as those of the cord, namely, in addition to the skin and superficial fascia, the inter-columnar, cremasteric, and infundibuliform fasciæ. The vessels, nerves, and vas deferens are behind the hydrocele.

XXVIII. 3.—A hydrocele of the spermatic cord. There are several very thin-walled cysts of different sizes communicating with each other, and nearly surrounding the upper and anterior part of the testicle; but none of them appears to communicate with the cavity of the tunica vaginalis.

XXVIII. 10.—A hydrocele of the spermatic cord. There is a single large membranous cyst immediately above and behind the testicle. Its inner surface is fasciculated, but lined by a smooth polished membrane. The opposite surfaces of the tunica vaginalis, which were adherent throughout, have been partially separated. The testicle is healthy.

XXVIII. 28.—A hydrocele of the spermatic cord. There are three distinct large cysts, which do not communicate; two of them are situate above the testicle and the third behind it.

HÆMATOCELE.

Hæmatocele of the cord is very rare. Like hydrocele of the cord it may be either diffused or encysted. Diffused hæmatocele is merely an effusion of blood in the cellular tissue of the cord; encysted hæmatocele is a collection of blood in the cavity of a former hydrocele. The following is one of the very few specimens, if not the only one, of this rare form of disease in the pathological Museums of London.

XXVIII. 11.—A large cyst in the spermatic cord, which contained blood. The cyst is situate just above the testicle, and the tissues around it are thickened, indurated, and consolidated. Part of the

tunica vaginalis has been removed; the opposite surfaces are completely adherent.

FATTY TUMOUR OF THE CORD.

XXXV. 66.—An elongated, lobed, fatty tumour, removed after death from the loose connective tissue of a spermatic cord.

DISEASES OF THE VAS DEFERENS AND VESICULÆ SEMINALES.

HYDATIDS OF THE VAS DEFERENS.

XXIX. 15.—A bladder, to the posterior part of which a cyst is attached, which contained acephalocyst hydatids. The vesiculæ seminales and vasa deferentia are closely connected with the cyst, and the lower part of the right vas deferens communicates with it by two orifices, into which a bristle is passed. A portion of this vas deferens is wanting, and it appeared that the cyst might have originated in the dilatation of the deficient portion of the tube. The walls of the cyst are thin, but tough and firm; the hydatids found within it are at the bottom of the bottle.

TUBERCLE OF THE VESICULÆ SEMINALES.

Tubercle of the vesiculæ seminales hardly ever occurs except in connection with tuberculous disease of the genito-urinary tract. Two good specimens follow.

XXIX. 20.—Vesiculæ seminales, prostate gland, and part of the bladder. Sections of the prostate and left vesicula seminalis exhibit tuberculous matter deposited in the interior of each. In the vesicula seminalis the tuberculous matter forms a uniform lining to the mucous membrane, the reticular arrangement of the surface of which remains distinct. In the prostate it is almost uniformly infiltrated through its left half, and some of it is softened. The right side of the prostate is nearly healthy.

From a young man in whom there were tubercles of the lungs and other organs.

His left kidney is preserved in XXVI. 27; the right kidney was healthy. The left testicle had tuberculous deposits in its interior; the right was healthy.

XXIX. 14.—Two specimens of vesiculæ seminales enlarged, indurated, and having deposits of tuberculous matter upon their lining membranes.

DISEASES AND INJURIES OF THE PROSTATE.

INFLAMMATION.

Inflammation of the prostate is commonly the result of the extension of inflammation from the urethra or bladder, of injury received in the passage of an instrument, or of the impaction of a calculus. It also occasionally occurs as an idiopathic affection in gouty and rheumatic subjects.

The inflammation may terminate in resolution, ulceration, supuration and abscess, or in chronic enlargement.

The following specimens of ulceration are the only examples of inflammatory affections of the prostate in the Museum.

XXIX. 10.—A prostate in each lateral lobe of which there is a large irregular cavity, formed by ulceration, and communicating with the urethra by the side of the caput gallinaginis. Urinary calculi have been formed in these cavities. The mucous membrane at the neck of the bladder and in the prostatic part of the urethra is diffusely ulcerated.

XXIX. 12.—A bladder and prostate. The middle lobe, which projects into the bladder, presents an ulcerated surface.

XXIX. 21.—A bladder and prostate. The prostate is greatly enlarged; its middle portion, projecting into the bladder, has been deeply torn by catheters which were arrested by it in the attempt to relieve retention of urine.

CHRONIC ENLARGEMENT.

Chronic enlargement of the prostate, though a common affection of advanced life, is not, as has been stated, a constant concomitant of old age; it must be distinguished from the chronic inflammatory enlargement, which may occur at any period of life. The disease under consideration may be due to a uniform hypertrophy of the normal tissues of the prostate generally, or of the muscular and fibrous tissues only; or, as is most commonly the case, to the presence of one or more distinct tumours embedded in, or of one or more distinct outgrowths springing from, the substance of the organ. Such tumours may resemble the normal prostate in structure; or the muscular, the fibrous, or the glandular elements may predominate.

The enlargement may uniformly affect the whole organ, or it may be confined to one or both of the lateral lobes or to the "posterior median portion" (the so-called middle lobe). Sometimes limited portions become pedunculated and project into the bladder.

When the enlargement is general the prostatic portion of the urethra is flattened laterally and increased in length, in extreme cases often measuring several inches. When only one of the lateral lobes

is enlarged the urethra is deflected to the opposite side; when the posterior median portion is chiefly affected the urethra turns suddenly upwards into the bladder at a right angle to the rest of the canal, the enlarged median portion standing up as an obstruction at the mouth of the bladder.

When the enlargement has existed some time the bladder becomes dilated and its muscular coat hypertrophied, from its endeavours to overcome the obstruction to the outflow of urine. As the vesical orifice of the urethra, in consequence of the enlargement of the prostate, is no longer at the most dependent part of the bladder, the urine cannot be completely voided, but collects in the fundus behind the prostate, and, becoming ammoniacal from admixture with mucus, deposits phosphates, in the form either of a calculus or of an incrustation upon the walls of the bladder.

The effects of the enlargement upon the urinary organs behind the seat of obstruction are similar to those that occur after stricture of the urethra. Thus, the mucous membrane of the bladder may become chronically inflamed, and, in some cases, ulcerated; the ureters may become dilated, and the kidneys more or less disorganized.

I. General enlargement.

Affecting the entire organ. XXIX. 3.—A bladder, with the prostate greatly and uniformly enlarged. The urethra within the prostate is deepened and laterally compressed. The muscular coat of the bladder is hypertrophied; bristles are passed beneath strong fasciculi of muscular fibres extending from the ureters to the neck of the bladder.

XXIX. 8.—A bladder, with the prostate, exhibiting a general enlargement of the prostate, with predominant enlargement of its "posterior median portion" (middle lobe). The enlarged middle lobe, and the portions of the prostate and of mucous membrane which connect it with the enlarged lateral lobes, form a ridge across the neck of the bladder, behind the orifice of the urethra. Through the middle of this ridge a passage was formed by a catheter.

Affecting chiefly the "posterior median portion" (middle lobe). XXIX. 6.—A bladder, with the prostate. The prostate is generally enlarged, but its posterior portion, or middle lobe, is enlarged much more than any other portion of it, and projects in the form of a round tumour into the cavity of the bladder, immediately behind the orifice of the urethra. The muscular coat of the bladder is hypertrophied. The ureters are dilated and thickened. Immediately above one of the ureters is a small cyst communicating with the bladder.

XXIX. 7.—A similar specimen; but the prostate, not being divided as it is in the preceding specimen, exhibits more plainly the manner in

which, when enlarged, it projects into the neck of the bladder, and especially the manner in which the enlarged middle lobe projects behind and above, and partially overhangs the orifice of the urethra.

Affecting chiefly the lateral lobes. XXIX. 1.—A prostate, with parts of the bladder and rectum. The prostate is greatly enlarged. The principal enlargement has taken place at the sides of the prostate and in the portion which is above and in front of the urethra: this portion is increased to upwards of an inch and a half in thickness, while the portion behind and below the urethra is scarcely thicker than is natural. The urethra within the prostate is flattened laterally, and contracted. A portion of glass is introduced into a passage made by a trochar during life, from the rectum through the prostate into the urethra. The orifices of the ureters are much dilated.

XXIX. 2.—A bladder, with the prostate enlarged and indurated. As in the preceding specimen, the chief enlargement is at the sides and anterior part of the prostate, but it is irregular, so that the urethra within the prostate is not only flattened but is also turned from its regular direction by portions of the prostate projecting into it.

XXIX. 18.—A bladder and prostate. The prostate is much enlarged, and distinct round portions of it project into the neck of the bladder, both behind and in front of the urethra. A portion of coloured glass is passed through the urethra within the prostate, which takes a very oblique course, in consequence, apparently, of the left lobe of the prostate being more enlarged than the right.

II. *Limited enlargements in the form of tumours or outgrowths.*

In the form of tumours. XXIX. 24.—The lower part of a bladder, with the prostate laid open from the front. The right lobe of the prostate is enlarged by the growth within it of a tumour over which its substance and capsule are thinly spread out. The tumour is of regular, roundly oval shape, measuring about one and a half and two inches in its diameters, closely invested by the prostate, yet easily enucleated from it. A portion of it thus separated is suspended above the bladder. Its cut surfaces show a very firm, dense texture, like that of a prostate, with numerous small cysts. The microscopic structures had the same likeness to those of a natural prostate. The prostatic part of the urethra is flattened by a projection of the side of the tumour, and curved towards the left side. A piece of glass marks a passage made with a catheter through the right lobe of the prostate, by the side of the tumour. The left lobe of the prostate appears of natural size.

From a man fifty-one years old, who, for two years before his death, had increasing difficulty in passing urine. Complete retention at length ensued, and was relieved with catheters, some or all of which passed through the prostate in the tract indicated in the specimen. After seven days, acute peritonitis, commencing apparently at the bladder, proved quickly fatal.

In the form of outgrowths. XXIX. 9.—Section of a bladder, prostate,

and urethra. The prostate is enlarged, and some tumours growing from it project into the bladder. There was a calculus in the bladder, which was removed by the lateral operation a fortnight before death; and in the progress of the operation one of the tumours arising from the prostate was completely detached. This tumour is suspended in the lower part of the bottle; it is of oval form, about three-quarters of an inch in diameter, and appears to have been attached by a small pedicle.

XXIX. 25.—A tumour, bisected, which was removed from the interior of a urinary bladder. It was attached just behind the orifice of the urethra, over the middle lobe of the prostate, by a band or pedicle, composed of mucous membrane and muscular fibres, and measuring about half an inch in width, and one-eighth of an inch in depth and thickness. The tumour (cut from the pedicle) is thinly invested with mucous membrane, like that of the bladder. It is of somewhat oval form, and measures from one and a half to two and a half inches in its several diameters. On its cut surfaces the tumour appears formed of very firm, tough, whitish substance, like that of a prostate. It is intersected by shining white circling bands of fibres, which divide it into close-packed lobes, and it contains many small round and oval cysts, lined with smooth membrane. The microscopic textures of the mass were exactly similar to those of prostate, including both gland-structures and well-formed smooth muscular fibres. The tumour may, therefore, be regarded as having grown, not within, but external to, the prostate, and as having projected into the bladder till it became pedicled.

The patient, sixty-four years old, was, for the last four years of his life, unable to pass urine without the help of the catheter. The tumour, as first seen after death, was described as "lying loose in the bladder, only connected to it by a pedicle, moving on this like a hinge, and, when pressed forwards, obstructing the orifice of the urethra."

XXIX. 26.—Portion of an enlarged prostate, of irregular shape, and measuring from an inch to an inch and a half in its several diameters, which was cut and torn off in an operation of lithotomy.

The patient was about forty years old, and had two large calculi. His recovery from the operation was quick, and apparently complete.

Specimens illustrating some of the methods of treating retention of urine from enlargement of the prostate.

By puncture of the bladder above the pubes. XXXIX. 16.—A bladder, with an enlarged prostate, from a man in whom the bladder had been punctured above the pubes eight years before death. The fistulous passage through which the urine was discharged is about four inches in length, and extends from the front of the bladder immediately above the prostate, through the abdominal walls. A piece of glass is introduced into this passage. The lateral lobes of the prostate are enlarged, and a distinct portion of the prostate, flattened and triangular, projects into the bladder immediately behind the orifice of the urethra.

By puncture through the rectum. XXIX. 1.—A prostate, with part of the bladder and rectum. A portion of glass is introduced into a passage made by a trochar during life, from the rectum through the prostate into the urethra.

Puncture of the bladder through the rectum for the relief of retention of urine is objectionable if the prostate is much enlarged; for either the instrument must be passed so high up the rectum to enable it to enter the bladder behind the large prostate that the recto-vesical pouch of the peritoneum will run grave risks of being wounded, or the trochar must be thrust through the prostate, a proceeding not only inflicting much injury upon the prostate, but also often failing in its object, as the point of the trochar (as seen in the above specimen) may enter the elongated prostatic urethra in front of the seat of obstruction, instead of entering the bladder.

By "tunnelling" the prostate. XXIX. 8.—A bladder and prostate. The enlarged middle lobe, and the portions of the prostate and of the mucous membrane which connect it with the enlarged lateral lobes, form a ridge across the neck of the bladder behind the orifice of the urethra. Through the middle of this ridge a passage was formed by a catheter.

XXIX. 24.—In this specimen a piece of glass marks a passage made by a catheter through the enlarged right lobe of the prostate for the relief of retention of urine. After seven days from the puncture acute peritonitis, commencing apparently in the bladder, proved quickly fatal.

"Tunnelling" the prostate, *i. e.* forcibly thrusting the catheter through the obstructing portion, as seen in the two preceding specimens, is objectionable. Puncture above the pubes is, in the author's opinion, by far the best method of treating retention of urine consequent upon enlargement of the prostate, if the ordinary use of catheters has failed.

CANCER OF THE PROSTATE.

Cancer of the prostate is rare. When it occurs it is nearly always of the medullary type. It has been observed only in childhood and advanced age. Its characters are well seen in the following specimens.

XXIX. 22.—A bladder and prostate of a child four years old. None of the natural structure of the prostate can be discerned; in its place there is a mass of soft, white, obscurely fibrous and shreddy medullary substance; nearly spheroidal in form, and four inches in diameter. This mass projects backwards between the bladder and the rectum, covering the pouch of peritoneum between them to the level of the upper part of the bladder; it must nearly have filled the pelvis.

The posterior and lower part is either superficially ulcerated or it has been broken. The peritoneum covering its upper part is extremely congested.

XXII. 17.—A bladder and prostate from a child five years old. The prostate is considerably enlarged both in its lateral and middle lobes. The natural structure of the prostate has entirely disappeared, and its place is occupied by medullary substance, a portion of which is of dark-greyish colour, perhaps from the deposit of melanotic matter. There are also similar dark-grey deposits in the cellular tissue around the prostate and neck of the bladder.

The child had been subject for four months to irritability of the bladder. Ten days before death it had retention of urine, which was succeeded by paralysis of the bladder.

TUBERCLE.

Tubercle in the prostate is rare, and is always associated with a general tubercular affection of the genito-urinary mucous tract.

Miliary tubercles are deposited in the connective tissue around the prostatic ducts and their terminal vesicles, and by undergoing caseous degeneration lead to the formation of distinct circumscribed patches of yellow caseous material. These ultimately coalesce, soften, and break down into pus, leaving, after the pus has made its way by ulceration into the bladder, urethra, or rectum, large irregular cavities, indistinguishable, except in being surrounded by tuberculous deposit, from those produced by ordinary inflammation and suppuration.

XXIX. 19.—Sections of a prostate from a young man, with round circumscribed masses of tuberculous matter deposited in it.

There were tubercles in the lungs and other organs. The kidney of the same patient is preserved in XXVI. 26, and the bladder in XXVII. 31.

XXIX. 23.—A prostate, of which nearly the whole substance has been destroyed by tuberculous ulceration. Only a thin shell of the prostate remains around a cavity with irregular walls, which was traversed by some cords of the indurated tissue of the prostate infiltrated with tuberculous matter, and which contained pus and detached portions of the organ. The cavity communicates by a wide orifice with the urethra.

The patient was an old man, who had tuberculous disease of the lungs, kidneys, testicles, and other organs. He died with inflammation of the bladder.

FATTY DEGENERATION.

XXIX. 28.—Portion of a prostate, which appears to have undergone a complete fatty degeneration of all its structures. Its cut surfaces have the aspect of a firm, minutely lobed, adipose tissue.

The patient was upwards of seventy years old. He had old stricture of the urethra, diseased bladder, and granular degeneration of the kidneys.

CONCRETIONS AND CALCULI.

Prostatic concretions are small, brownish or blackish, seed-like bodies, often found in abundance in the ducts and follicles of the prostate of elderly people. They may be seen, on microscopical examination, in the prostate at early periods of life as soft, pale yellow bodies, but it is only in later years that they become visible, as dark specks, to the naked eye. They appear to be formed of inspissated prostatic secretion intermingled with phosphates of lime. As they increase in size the follicles in which they have been formed become dilated around them into small cysts.

In some instances one or more may become abundantly coated with phosphate and carbonate of lime, when they are generally spoken of as prostatic calculi.

Prostatic calculi assume various forms and sizes; they are hard in consistence, and vary in colour from white to pale brown. When large they may project into the urethra, causing retention of urine, and they have been known to protrude from the urethra into the bladder. They may give rise to abscess of the prostate or make their way by ulceration into the rectum or bladder.

XXIX. 4.—A prostate, in which numerous small cysts are filled by brown calculi.

XXIX. 5.—A similar specimen, but with smaller cysts and calculi.

XXX. 6.—Part of a penis and prostate. A small calculus is fixed in the dilated orifice of one of the prostatic ducts.

XXXVI. 49.—Numerous small round calculi from the prostate composed of phosphate of lime.

INJURIES AND DISEASES OF THE BLADDER.

RUPTURE.

Rupture of the bladder is commonly the result of external violence, such as a fall or blow upon the abdomen when the bladder is distended. It is a frequent complication of fracture of the pelvis. Simple over-distension, such as occurs in consequence of stricture of the urethra, seldom, if ever, leads to rupture, as the walls of the viscus, as already explained, become hypertrophied during the formation of a stricture, and are therefore rendered capable of resisting

the pressure of the retained urine; in such a case it is invariably the urethra behind the stricture which gives way.

When the peritoneum is ruptured, as is most commonly the case, the urine necessarily escapes into the peritoneal cavity and sets up acute peritonitis, which is almost invariably followed by death. When the anterior wall alone is ruptured the peritoneum is not involved, and the urine is extravasated into the loose cellular tissue of the pelvis.

The direction of the rupture is generally vertical and the edges of the rent are usually ragged and flocculent.

XXVII. 21.—A bladder, exhibiting a rupture of its anterior wall in a line from the prostate to the fundus. The rupture was produced by a blow on the abdomen.

XXVII. 47.—The bladder of a man, aged forty-five; the upper and back part of the fundus has been ruptured. The hole is large enough to admit a quill on the outside, but of greater extent on the inside. The lining membrane of the bladder is ecchymosed in patches. The whole viscus is thickened, and large fasciculi appear on the inner surface. The membranous portion of the urethra is contracted, and beaded with small nodules of inflammatory material. The pelvis contained much blood and urine. The rupture was the result of severe injury to the abdomen. The patient died four days afterwards of peritonitis. He had suffered from stricture for years.

SPECIMENS ILLUSTRATING THE CONDITION OF THE BLADDER AND NEIGHBOURING PARTS AFTER THE OPERATIONS OF LITHOTOMY, LITHOTRITY, AND PUNCTURE.

After Lithotomy.

Four of the following specimens well illustrate the condition of the wound in the prostate and neck of the bladder at different periods after the operation of lithotomy.

A few days after the operation. **XXVII. 11.**—A bladder, showing the incision in the neck made in the performance of lithotomy.

XXVII. 12.—The bladder, ureters, and kidney of a child, showing the incision made in the performance of lithotomy a few days before death.

A fortnight after the operation. **XXVII. 18.**—The bladder and rectum of a child, upon whom the operation of lithotomy was performed about a fortnight before death. A bristle is passed through the track of the wound.

Five years after the operation. **XXVII. 23.**—A bladder and kidneys of a man, upon whom the operation of lithotomy was performed five years before death. The cicatrix in the mucous membrane between the prostate and neck of the bladder is distinctly visible.

Ulceration of the bladder. **XXVII. 13.**—The bladder, urethra, and a portion of the os pubis of a man, upon whom the operation of lithotomy

had been performed. A portion of the front of the bladder is destroyed by ulceration; the remaining part is thickened and diffusely ulcerated.

After Lithotrity.

XXVII. 30.—A bladder, with part of the urethra of a man on whom the operation of lithotrity was performed. There were two calculi in the bladder; one of moderate size, which was broken by the instrument; the other, of larger size, was not detected by the instrument, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part, immediately behind the prostate. The calculi are in XXXVII. 141. See also XXVII. 49.

After Puncture.

Through the rectum. XXVII. 10.—A bladder behind which is a sac nearly as large as itself. Above the communication of the sac with the bladder is an orifice which was made by a trochar introduced from the rectum for the relief of retention of urine.

XXIX. 1.—A prostate with part of the bladder and rectum. The prostate is greatly enlarged. A portion of glass is introduced into a passage made by a trochar during life from the rectum, through the prostate into the urethra.

The better treatment would have been to have punctured the bladder above the pubes.

Above the pubes.—XXVII. 28.—A bladder and urethra of a man in whom the bladder was punctured twelve years before death. Connected with the front of the bladder is a fistulous tract extending through the parietes of the abdomen through which the patient discharged his urine from the time of the puncture of the bladder to his death; it is lined by a membrane similar to and connected with the mucous membrane of the bladder.

XXIX. 16.—A bladder, with an enlarged prostate, from a man in whom the bladder had been punctured above the pubes eight years before death. The fistulous passage through which the urine was discharged is about four inches in length, and extends from the front of the bladder immediately above the prostate through the abdominal walls. A piece of glass is introduced into this passage.

CYSTITIS.

Cystitis or inflammation of the mucous membrane of the bladder may be either acute or chronic.

Acute Cystitis.

Acute cystitis is rare. It is generally the result of direct irritation or injury of the mucous membrane; hence it is occasionally met with after lithotrity or the retention of a catheter in the

bladder. It may also occur in the course of chronic cystitis, or rarely as an idiopathic affection.

The mucous membrane appears vividly injected, swelled, roughened on its surface and covered with the products of inflammation. In severe forms it assumes a dark red or purple colour. The inflammation may terminate in suppuration, ulceration, or gangrene, all of which may exist at the same time in different parts of the bladder. In rare instances the mucous membrane may die and be cast off in one piece, leaving the muscular coat exposed. The detached mucous membrane has occasionally been passed by the urethra. In the less severe forms the inflammation may either terminate in resolution or may pass into the chronic condition.

XXVII. 49.—A bladder with portion of the urethra, from a man, aged seventy-three, on whom the operation of lithotomy had been performed, and who died twelve days after the last crushing. The bladder, which is somewhat thickened, presents the usual appearances of acute ulcerative cystitis; a few fragments of calculus were found loose in its cavity, but the greater portion was found impacted in two small pouches of about the size and shape, each of them, of a cob-nut. The fragments had evidently become impacted after the operation. The pouches are in the more dependent part of the bladder, near the orifices of the ureters, of which, however, they formed no part.

XXVII. 51.—The specimen is apparently nearly the whole of the mucous membrane of the urinary bladder with a portion of the muscular coat, which was passed during life, by a woman aged twenty-six, from the urethra. A month previously she was admitted into the hospital on account of retention with incontinence of urine, and retroversion of the uterus, being about four months pregnant. Soon after her admission ninety-six ounces of urine were drawn off with a catheter, and the urine was subsequently drawn off regularly every few hours.

The expulsion of the specimen from the bladder was preceded by retention and acute pain in the hypogastrium, and on examination, the urethra being found blocked up by some white-looking substance, the specimen was removed. For some months afterwards the patient was unable to hold her urine for more than from five to twenty minutes at a time. When last seen (about eight months afterwards) she was in much the same condition. Her general health was good.

She was delivered of a healthy child, at about the full time.

XXVII. 48.—Urinary bladder from a woman aged thirty-four. Except for an inch in breadth around the orifice of the urethra, where the mucous membrane still exists, the muscular coat of the bladder is everywhere exposed, the lining membrane everywhere destroyed. The bladder is rather large, the urethra natural. The ureters were dilated to the size of the little finger, and their orifices into the bladder would admit a goose quill; their lining membrane is natural. The kidneys were affected with diffused suppurative nephritis, and their pelves dilated.

Chronic Cystitis.

This is usually due to the extension of inflammation from the urethra to the bladder, the irritation of calculi, the presence of unhealthy urine, or the too frequent passage of catheters. The mucous membrane appears thickened, velvety, congested, of a dark red colour, and covered with an abnormal secretion of mucus, or with muco-pus, or, when the disease has lasted some time, with a deposit of phosphates. The mucous membrane is easily detached and is often found destroyed in places by ulceration or by suppuration. The muscular coat thus exposed becomes hypertrophied from irritation, or may even, in severe cases, participate in the inflammation.

XXVII. 19.—A bladder, in which nearly the whole of the mucous membrane has been removed by ulceration.

XXVII. 20.—A similar specimen, showing more plainly the enlarged fasciculi of the muscular coat exposed by the ulceration.

Abscess.—XXVII. 34.—A bladder, in the posterior wall of which two abscesses have formed. The cavities of the abscesses are exposed by the removal of the peritoneum; they occupied circumscribed spaces between the peritoneal and mucous membranes, in which spaces the muscular fasciculi alone remain, the cellular tissue between them having been destroyed in the suppuration. In several places also the mucous membrane lining the intermuscular spaces has been destroyed, so that the abscesses communicated with the cavity of the bladder.

HYPERTROPHY AND SACCULATION.

Hypertrophy of the bladder is generally associated with some obstruction to the urinary outlet, or with the presence of a foreign body in the bladder; and is the result of the constant action of the muscular fibres to overcome the obstruction, or to expel the foreign body. The hypertrophied muscular fibres give to the interior of the bladder a columnar and rugose appearance, somewhat resembling the interior of the ventricles of the heart. The mucous membrane may be thickened, or ulcerated and in great part destroyed. In conjunction with the hypertrophy the bladder may be either contracted or dilated. The dilatation may be general, or confined to certain portions of the walls. The partial dilatations, called *sacculi*, consist either of all the coats, or, as is more commonly the case, of the mucous membrane only, protruded between the fasciculi of the hypertrophied muscular fibres from the pressure of the retained urine. Such a pouch, often spoken of as a *hernia* of the mucous membrane, when once formed may go on enlarging until it nearly, or quite, equals the bladder in size and becomes a receptacle for urine, or even for calculi.

Sacculi, formed by protrusions of mucous membrane, are often seen in different stages of formation in the same bladder.

Simple hypertrophy.

From stricture. XXX. 15.—A bladder and urethra. A stricture of the urethra exists immediately behind the bulb; the muscular coat of the bladder is hypertrophied; it is half an inch in thickness, and its fasciculi project in strong columns or ridges on its inner wall.

From enlarged prostate. XXIX. 3.—A bladder, with the prostate greatly and uniformly enlarged. The urethra within the prostate is deepened and laterally compressed. The muscular coat of the bladder is hypertrophied; bristles are passed beneath strong fasciculi of muscular fibres, extending from the ureters to the neck of the bladder.

From the irritation of a calculus. XXVII. 11.—A bladder, the coats of which are much thickened and indurated in consequence of the lodgment of a calculus in its cavity. The muscular coat is in some parts nearly half an inch thick, and the mucous membrane forms a tough white layer, from one to three lines in thickness, and raised in prominent folds in the cavity of the contracted bladder.

From the irritation of a tumour in its interior. XXVII. 25.—The muscular coat of the bladder in this specimen is hypertrophied in consequence of the irritation of a villous tumour growing from its mucous membrane.

From phimosis. XXVII. 29.—The bladder, ureters, and kidneys, of a boy, thirteen years old; the bladder is contracted, its muscular coat hypertrophied, and its mucous coat is ulcerated. The ureters are very tortuous and widely dilated, and their walls are thickened. The mucous membrane of each is rough, and pus is in some parts deposited upon it. The pelves and infundibula of both kidneys are also widely dilated, thickened, and rough on their internal surfaces from similar deposit. The kidneys appear enlarged by the dilatation of their pelves and infundibula, but their glandular substance forms only a thin layer on their surfaces.

The patient had phimosis, and had suffered for four years with incontinence of urine. For three months before death he had severe symptoms like those of stone in the bladder. The operation for phimosis was performed, but he died exhausted.

Phimosis, *i. e.* an elongated and contracted condition of the prepuce, in consequence of the impediment which it offers to the outflow of urine, may produce the same effects upon the urinary organs (well seen in the above specimen) as those already described as occurring after stricture. Phimosis is, moreover, often productive, as in the case of the child from whom the above specimen was taken, of symptoms similar to those of stone in the bladder.

Without any evident cause. XXVII. 14.—The bladder of a child in

which the muscular coat is exceedingly hypertrophied. Its other tissues appear healthy.

The child was four years old and suffered intensely with signs of stone in the bladder, but no stone existed, nor was any disease found in the urethra or other part of the urinary system.

Hypertrophy with sacculation—the sacculation consequent upon the partial dilatation of all the coats of the bladder.

XXVII. 32.—A bladder with an enlarged prostate. The bladder is much thickened. At the upper and back part, immediately above the orifice of the left ureter, a portion of the bladder is distended into a sac of considerable size, of which the walls are thinner than those of the rest of the bladder, although all the coats appear to be comprised in the dilatation.

XXVII. 30.—A bladder, with part of the urethra, of a man on whom the operation of lithotomy was performed. There were two calculi in the bladder; one of moderate size, which was broken by the instrument; the other, of larger size, was not detected by the instrument, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part, immediately behind the prostate.

XXVII. 17.—Sections of a dried bladder, of a very large size, and with numerous cysts communicating with the posterior and lateral parts of its cavity. Within two of these cysts calculi are lodged.

Hypertrophy with sacculation—the sacculation consequent upon the protrusion of the mucous membrane between the fasciculi of the muscular coat. (Hernia of the mucous membrane.)

XXVII. 33.—The bladder of an old man, who had long suffered with stricture of the urethra. Its muscular coat is thick, but weak and flaccid, and the mucous membrane is depressed in pits between the muscular fasciculi. On the right side are two large thick-walled sacs, each between three and four inches in diameter, communicating with the bladder by two small round apertures, and separated from each other by a partition formed by the union of their adjacent walls. They appear to have been formed by portions of the mucous membrane protruded, like herniæ, between fasciculi of the muscular coat, and growing and thickening as they were gradually dilated.

XXVII. 10.—A bladder, behind which is a sac nearly as large as itself. The sac, which probably had its origin in the protrusion of the mucous membrane of the bladder between its muscular fibres, communicates with the cavity of the bladder by a small round opening just above the orifice of the right ureter. The muscular coat of the bladder is much thickened; its mucous membrane is healthy, but depressed in small pits between the muscular fibres. Above the communication of the sac with the bladder is an orifice, which was made by a trochar introduced from the rectum, for the relief of reten-

tion of urine. There is a smaller sac communicating with the bladder above the termination of the left ureter.

XXVII. 41.—A bladder and part of the urethra, laid open on their anterior aspect. The muscular wall of the former is hypertrophied. Its mucous membrane is thick and coarsely rugous. On the right side, just above the orifice of the ureter, a narrow, funnel-shaped opening leads to a large pouch lined by a mucous membrane, but devoid of muscular tissue.

From the body of a man who had suffered from stricture of the urethra.

DILATATION OF THE BLADDER.

ˆ Dilatation of the bladder may, as already seen, be associated with hypertrophy of the muscular coat. It is said to exist, however, without any hypertrophy of the walls in some cases of enlarged prostate. There is no specimen resembling this condition in the Museum.

TUBERCULAR DISEASE.

Tubercular disease of the bladder is characterized by the presence in the mucous membrane of numerous small, circular, distinct ulcers with thickened edges. It begins by the formation of miliary tubercles in the lymphatic tissue of the submucous coat. The tubercles here, as in other situations, undergo caseous degeneration and softening; and ulceration of the mucous membrane covering them follows, producing the characteristic appearance above described. Fresh tubercles form around and undergo similar changes leading to the formation of fresh ulcers, which by encroaching upon and coalescing with those previously formed, give rise to a deep, irregular ulcer with thickened edges.

The disease is frequently associated with a general tubercular condition of the genito-urinary mucous tract.

XXVII. 31.—A bladder, exhibiting numerous distinct circular ulcers in its mucous membrane. At the bases of some of these ulcers there are small tubercular deposits. The intervening portions of the mucous membrane, to the borders of the ulcers, are healthy.

From the same man as the tuberculous kidney in XXV. 26. There were tubercles in the lungs and other organs.

XXVII. 40.—Part of a bladder and its ureters. The entire mucous surface of the former is converted into a rough villous texture, being part of a layer of considerable thickness which has taken the place of the natural lining. In the recent state it was soft and of a pale yellow colour, and was formed by a deposit of tubercular matter in the mucous and submucous tissues. This condition extends up to the left ureter, and involved the calices and tubuli of the corresponding kidney. The right ureter remains unaffected.

Part of the penis, including the glans, is suspended in front, and the urethra is laid open, to show that the diseased condition prevails to its very extremity.

From the body of a boy, who had long suffered from symptoms of vesical disease, which at first simulated those of a calculus in the bladder. Large quantities of broken-down tuberculous material were constantly passed with the urine. A drawing of the kidney, No. 283, shows its recent appearance.

NEW GROWTHS.

Fibrous or polypoid growths.

These growths, generally known as polypi, occur as sessile or as pedunculated tumours projecting into the interior of the bladder. They are usually perfectly innocent, being composed of fibrous or of fibro-myxomatous tissue. At times, however, sarcomatous elements have been found entering into their composition.

Springing from the submucous tissue, they protrude the mucous membrane before them, and appear, when viewed from the inside of the bladder, as flattened elevations; as they increase in size they assume a polypoid form, becoming irregular and warty on the surface. All varieties, from a simple flattened elevation to a complete polypoid mass, are often seen in the same specimen. Their common seat is the lower and back part of the bladder; they generally occur in young subjects, and are more common in girls than in boys. Obstruction to the escape of urine is the common cause of death.

XXVII. 39.—A bladder laid open by a vertical incision through its anterior wall. A pedunculated growth is attached to its inner surface, stretching transversely across the fundus of the bladder immediately behind the aperture of the ureters. The mass is attached at either side, but free in the centre, and was so situated that it might lie over the urethral orifice or be propelled in that direction when attempts were made to void urine. The growth, irregularly lobulated, consists of a fine, filamentous structure scattered through a granular substance invested by tessellated epithelium.

From a child who had suffered for eight weeks from extreme pain during micturition, frequently followed by severe pain in the abdomen.

Villous or papillomatous growths.

These tumours, called villous from their appearance and papillomatous from their microscopic structure, are soft, flocculent, fringe-like bodies, resembling the villi of the chorion, attached by a narrow stem to the mucous membrane of the bladder. They are

innocent and must be distinguished from a villous form of epithelioma which they greatly resemble and with which they were formerly confounded. They consist of numerous branching processes composed of a basis of fibrous tissue supporting numerous dilated and tortuous blood-vessels and covered with layers of epithelium resembling those of the mucous membrane of the bladder. They seldom attain a large size, rarely exceeding that of a small chestnut, and are generally multiple, many smaller growths being scattered over the mucous membrane around the larger tumour. They are attended by slight but constant bleeding. Exhaustion from continual loss of blood is the common cause of death.

XXVII. 2.—A bladder, with a soft and shreddy villous tumour growing from the mucous membrane near the centre of its posterior wall.

XXVII. 6.—A bladder exhibiting several irregular papillomatous growths projecting into its interior.

XXVII. 25.—A bladder, with an uniformly enlarged prostate. The muscular coat of the bladder is hypertrophied. A soft, flocculent, and very vascular growth is attached by a narrow base to the mucous membrane at the lower and posterior part of the bladder, immediately behind the orifice of the urethra. The morbid growth was the source of frequent and profuse hæmorrhage.

Cancer.

Cancer of the bladder may be a primary affection or an affection secondary to cancer of neighbouring parts.

Primary cancer.—Primary cancer is generally medullary, rarely scirrhus or epitheliomatous.

The medullary variety begins within the walls, and as it increases in size projects as a distinct tumour into the cavity of the bladder, which, in some instances, it may at length almost or entirely fill. The surface of the cancer may be ragged and flocculent, or, in some instances, irregularly broken down by ulceration, or, again, smooth but nodular.

The scirrhus form occurs as a general infiltration of the walls of the bladder rather than as a distinct tumour, rendering the walls of the bladder hard and unyielding.

The epitheliomatous form appears as a warty or villous excrescence of the mucous membrane, having the usual characters of epitheliomata of other parts.

All the forms of cancer spread to the neighbouring parts, and the medullary and scirrhus, as in other situations, affect distant organs.

Secondary cancer.—When extending from the uterus the cancer

is commonly epitheliomatous or scirrhus; when from the prostate, medullary; and when from the rectum, scirrhus or epitheliomatous (glandular).

Primary cancer.

Medullary. XXVII. 27.—The bladder of a woman, with its cavity nearly filled by a large tumour which apparently originated within the coats of its posterior part. Portions of glass are passed into the ureters, which open on the front surface of the tumour. The tumour is pale, soft, spongy, and of medullary character.

XXVII. 50.—Medullary carcinoma of the urinary bladder from a man aged fifty-seven, who had had symptoms of disease for about six months before death. Two large masses of disease are to be seen which affect the muscular as well as the mucous coat of the bladder, whilst the lesser raised patches are limited to the mucous membrane, and even to its more superficial layers. Whether their mode of origin is by direct extension from the larger masses, or by transplantation of cancer-cells from the surface of these upon different portions of the surface of the mucous membrane during an empty state of the bladder, seems not certain. Around the opening of the right ureter is a mass of cancer infiltrating the muscular coat.

XXVII. 15.—A bladder, exhibiting a general thickening of its coats and a large mass of soft medullary cancer attached to the mucous membrane of its posterior wall, just above the prostate. A sac, as large as the bladder itself, and filled by a similar medullary growth, communicates with the lower and posterior part of the bladder. This sac was situated between the muscular coat of the bladder and the peritoneum covering its posterior wall; one of the ureters terminates in it, by an opening through which a quill is passed. A passage has been formed through the prostate by a silver catheter.

The man from whom the specimen was taken had had difficulty in passing urine and occasional retention for two years. In the last attack of retention the prostate as shown in this specimen was pierced; but the withdrawal of the urine did not reduce a swelling which could be felt above the pubes, and which was produced by the bladder pressed forward by the cyst full of medullary substance. It is uncertain whether this cyst be formed by dilatation of the ureter or by mucous membrane protruded from the bladder between its muscular fibres; the latter supposition is the more probable.

XXVII. 5.—A bladder, in which there is a mass of soft, broken, medullary substance occupying the whole thickness of the coats of its fundus.

XXVII. 7.—A bladder, half the cavity of which is filled by a broken, soft, and flocculent growth proceeding from its mucous membrane. The rest of its internal surface is superficially ulcerated.

XXVII. 44.—The bladder of a man aged fifty-nine, on the lower portion of the anterior wall of which is a considerable growth of cancer. Portions of the disease project into the adjacent parts of the cavity. The prostatic portion of the urethra is distorted.

XXVII. 45.—The bladder of a man aged forty-five, who for two or three years before his death had suffered from hæmaturia and other symptoms of a foreign body in the bladder. The bladder is laid open by a vertical incision through its front wall. This is much thickened and indurated; and springing from the region of the neck, and so extending as to involve the orifices of the ureters and urethra, is a large lobulated cancerous tumour which occupies a considerable portion of the cavity. The lower surface is ulcerated.

CALCULUS IN THE BLADDER.

VARIETIES OF CALCULI.

The calculi most frequently met with in the bladder are the uric acid, the oxalate of lime, and the fusible or mixed phosphate. The rarer forms are the urate of ammonia, the cystic oxide or cystine, the phosphate of lime, the phosphate of ammonia and magnesia or triple phosphate, the carbonate of lime, the xanthic or uric oxide, the fibrinous, the blood, the uro-stealith, and the silicious. The seven latter are exceedingly rare.

Uric acid calculi.

Uric acid, or lithic acid calculi, as they were formerly called, are usually small, but may attain a considerable size; they are oval, smooth, or finely granular, hard, give a clear, ringing sound when struck, are of a nut-brown colour, and laminated on section. The harder forms have a conchoidal fracture. The nucleus is generally composed of uric acid, sometimes of oxalate of lime, and is generally formed in the kidney by the aggregation of urinary deposits. They are most frequent in youth and middle age. See XXXVI. 1, 2, 3, 5, 6, 8, 9, and many others.

Urate of ammonia calculi.

Urate of ammonia calculi are usually small, oval, smooth, earthy, brittle, of a pale fawn or clay colour, and homogeneous or indistinctly laminated on section; their fracture is earthy. They are less frequently met with than uric acid calculi on account of the greater solubility of urate of ammonia. They are most common in children. See XXXVI. 30, 139, and 152.

Oxalate of lime calculi.

Oxalate of lime, or mulberry calculi, as they are often called from their resemblance (when first removed, covered with blood, from the bladder) to a mulberry, are generally of moderate size, globular,

uneven, tuberculated, of a reddish-brown colour, very hard, and crystalline on section. The nucleus is generally oxalate of lime, but it may be uric acid or urate of ammonia; it is usually formed in the kidney. Oxalate of lime calculi are most frequently met with in the middle periods of life. See XXXVI. 21, 23, 31, 33, 34, and many others.

Several varieties of oxalate of lime calculi are described. The following are contained in the Museum:

1. *The hemp-seed calculus*, so called by Dr. Wollaston from its resemblance to a hemp-seed, is small, smooth, globular, and pale in colour.

XXXVI. 37.—Section of a calculus of the kind commonly called "hemp-seed calculus;" nucleus uric acid, covered by a smooth layer of oxalate of lime.

2. *The pure white oxalate of lime*. XXXVI. 137.—Calculus of oxalate of lime. Pure white oxalate of lime deposited upon brown oxalate of lime.

Phosphatic calculi.

Three forms of phosphatic calculi occur—(1) The phosphate of lime or earthy phosphate; (2) the phosphate of ammonia and magnesia, or triple phosphate; and (3) the phosphate of lime with phosphate of ammonia and magnesia, the mixed or fusible calculus. The two first are rare, the last is common.

1. *Phosphate of lime or earthy phosphate*.—Calculi composed of phosphate of lime uncombined with other salts are rare. The following specimen consists of thirty-one calculi of this description, which were removed from one bladder. XXXVI. 92 is a calculus of pure phosphate of lime removed from the kidney, and XXXVI. 156 and 197, are calculi composed of phosphate of lime combined with other salts.

XXXVI. 220.—Thirty-one calculi removed from a Hindu peasant, aged thirty-five. They are composed of phosphate of lime.

2. *Phosphate of ammonia and magnesia (triple phosphate)*.—Calculi composed entirely of the triple phosphates are rare; there are no specimens in the Museum. XXXVI. 95 is a calculus composed in great part of triple phosphates deposited upon, probably, a nucleus of uric acid; and XXXVI. 93 are fragments of a calculus composed of the triple phosphates passed from the bladder through the urethra.

3. *Phosphate of lime with phosphate of ammonia and magnesia, the mixed or fusible calculus*.—The "mixed calculi," consisting of phosphate of lime with phosphate of ammonia and magnesia, or fusible calculi as they are also called because they are readily fusible

before the blowpipe, are by far the most common of the phosphatic calculi. They are especially the calculi of the later periods of life. They vary in shape and size, and are usually smooth, soft, friable, earthy, and laminated on section.

They are commonly formed in the bladder, their nucleus consisting of one of the other forms of calculi or of some foreign body other than a calculus, as a piece of catheter, a hair-pin, blood, fibrine, &c.

They are produced as follows:—The calculus or other foreign body causes irritation of the mucous membrane and consequently the secretion of an alkaline mucus; the mucus causes the resolution of urea contained in the urine into carbonate of ammonia, the carbonate of ammonia unites with the acid phosphates, and an insoluble mixed phosphate of ammonia, magnesia, and lime is thrown down and deposited upon the foreign body. See XXXVI. 15, 42, 43, 45, 47, 120, 143, and several others.

Cystine or cystic oxide calculi.

The cystine or cystic oxide calculi are rare. They are usually globular, smooth, or smoothly tuberculated, soft, semi-transparent, waxy looking, yellowish-brown when recent, greenish-blue when preserved for some time, and not laminated on section. They contain a large percentage of sulphur, and are of renal origin.

XXXVI. 114.—Section of a cystic oxide calculus, coated in parts by the mixed phosphates.

XXXVI. 118.—The half of a large cystic oxide calculus, with a nodular and apparently crystallized surface.

XXXVI. 203.—One half of a cystic oxide calculus removed from a boy, aged fourteen. It weighed seven drachms. Symptoms of irritation of the urinary organs had existed from early childhood.

XXXVI. 207.—The half of a large cystic oxide calculus. It is kidney shaped, and its surface is beaded, and presents the usual waxy appearance.

Removed from a girl aged seventeen.

Carbonate of lime calculi.

Carbonate of lime calculi are very rare. There are several calculi in the Museum containing small quantities of carbonate of lime (XXXVI. 52, 149, and 154), but none composed chiefly of this salt, excepting one from the bladder of a horse (XXXVI. 184).

Xanthic or uric oxide, blood, uro-stealith, fibrinous, and silicious calculi are very rare. There are no specimens in the Museum.

STRUCTURE OF CALCULI.

Although, as we have seen, calculi may be chiefly composed of one constituent, they are more often composed of several, which may be arranged in alternate layers around a nucleus (alternating calculus). The nucleus usually consists of uric acid, urate of ammonia, or oxalate of lime, in which cases it is commonly formed in the kidney by the aggregation of urinary deposits, becoming coated by the same or by other deposits upon its descent into the bladder. After the calculus has existed some time in the bladder it generally becomes encrusted by a layer of phosphates, as described under phosphatic stone, in consequence of the irritation of the mucous membrane. But the nucleus may consist of a foreign body introduced into the bladder, such as a portion of a gum-elastic catheter or of a bougie, or fibrine or blood, &c.; in such cases the calculus commonly consists of phosphates throughout. In rare instances no nucleus can be discovered; it is probable that in such cases the calculus was formed around some animal matter, such as blood or fibrine, which afterwards broke down, giving rise to the appearance of a cavity in the centre of the calculus. The formation of layers of different composition in a calculus is due to the varying state of the health of the patient and the condition of the mucous membrane of the bladder.

Calculi of various composition, in two layers.

Nucleus, uric acid. XXXVI. 77.—Section of a calculus; nucleus, uric acid, surrounded by a thin layer of urate of ammonia.

XXXVI. 16.—Section of a calculus; nucleus, uric acid, with a coating of the phosphates. See also XXXVI. 78, 150.

Nucleus, urate of ammonia.—XXXVI. 106.—Sections of a calculus; nucleus, urate of ammonia, outer portion nearly pure uric acid.

XXXVI. 136.—Calculi; nucleus, urate of ammonia; remainder, oxalate of lime and urate of ammonia in alternate layers.

XXXVI. 71.—Calculus; nucleus, urate of ammonia; exterior fusible. See also XXXVI. 76, 179.

Nucleus, oxalate of lime. XXXII. 53.—Sections of a calculus; nucleus, oxalate of lime, surrounded by uric acid. See also XXXVI. 86, 116, 151.

XXXVI. 29.—Calculus; nucleus, oxalate of lime, covered by crystals of phosphate of magnesia and ammonia (triple phosphate).

XXXVI. 197.—A large calculus; nucleus, oxalate of lime; the circumference, phosphate of lime, with small portions of urate of ammonia and carbonate of lime.

XXXVI. 59.—Section of a calculus; nucleus, oxalate of lime, with a crust of fusible calculus. See also XXXVI. 62, 79, 82.

Calculi of various composition, in three layers.

Nucleus, uric acid. XXXVI. 84.—Section of a large calculus; nucleus, uric acid; around it a thin layer of oxalate of lime; the outer white layer, fusible phosphates.

XXXVI. 124.—Section of a calculus; nucleus, uric acid; surrounding grey band, urate of ammonia; remainder fusible phosphates, with crystals of the phosphate of ammonia and magnesia.

XXXVI. 175.—Calculus; nucleus, uric acid, surrounded by a layer of uric acid, urate of ammonia, and earthy phosphates; external layer, triple phosphates.

Nucleus, urate of ammonia. XXXVI. 7.—Section of a calculus; nucleus, urate of ammonia, surrounded by oxalate of lime nearly pure; remainder, uric acid with a little oxalate of lime.

XXXVI. 24.—Section of a calculus; nucleus, urate of ammonia; the greater portion oxalate of lime coated by the fusible phosphates. See also XXXVI. 25 and 135.

Nucleus, oxalate of lime.—XXXVI. 85.—Section of a calculus; nucleus, oxalate of lime surrounded by impure uric acid, a thin layer of urate of ammonia with oxalate of lime coating the whole.

Calculi consisting of more than three various layers.

XXXVI. 10.—Sections of a calculus; nucleus, uric acid surrounded by a thin layer of oxalate of lime; around this, uric acid nearly pure; the remainder, uric acid and oxalate of lime in alternate layers.

XXXVI. 32.—Sections of a calculus; nucleus, urate of ammonia with some lime; next, oxalate of lime; then, uric acid with a small quantity of the phosphates; and lastly, a thin layer of urate of ammonia containing oxalate and phosphate of lime, and coloured by purpurate of ammonia.

XXXVI. 51.—Section of a calculus; nucleus, urate of ammonia with oxalate of lime, surrounded by oxalate of lime; the remainder may be divided into three portions, the inner one consisting of phosphate of lime with phosphate of ammonia and magnesia, and a little carbonate of lime; the middle, which is much harder in texture and more compact, of phosphate of lime and carbonate of lime; and the outer of phosphate of ammonia and magnesia and phosphate of lime. See also XXXVI. 54, 72, 96, &c.

Nucleus formed of a foreign body introduced from without.

XXXVI. 45.—Sections of a calculus; triple phosphate, with phosphate of lime deposited around a piece of the stilet of a catheter, which is bent into the form of a hook. XXXVI. 174, a somewhat similar specimen.

XXXVI. 91.—Fusible calculous matter deposited around a piece of paper which had been passed into the urethra of a female.

XXXVI. 194.—Portion of sealing wax which had been introduced into the bladder three years prior to its extraction. It is almost entirely encrusted with calculous matter.

XXXVI. 196.—Parts of a gutta-percha bougie, about five inches in length, encrusted with deposits of urate of ammonia, ejected from a man's urinary bladder after being broken into several pieces by lithotrity.

When this instrument was being passed, twenty-seven days prior to its removal, it broke between four and five inches from the distal extremity, the fragment being left in the urethra. Its removal was at once attempted by cutting into the urethra through the perinæum, but a spasmodic action of the membranous portion ensued, and the whole fragment was drawn into the bladder. It there lay across the neck, was readily reached by the lithotrite, turned, and an effort made to withdraw it; subsequently it was broken into several pieces, portions removed between the blades of the instrument, and the remainder expelled with a violent rush of urine in two acts.

XXVII. 52.—Three pieces of india-rubber tubing found, thickly encrusted with phosphates, in the bladder of a man aged thirty-five, who was admitted into the hospital with symptoms of stone.

He stated that a few months back he had fallen astride a board and struck the perinæum; that after the accident he passed bloody urine some days, and that ever since he had had much difficulty in holding his water, which was always thick. He persistently denied that an instrument had ever been passed into his bladder.

Lithotomy was performed four times, as his bladder was thought to contain a soft calculus. He died from acute inflammation of the whole genito-urinary tract.

XXXVI. 231.—A hairpin, which became the nucleus of a phosphatic calculus, removed from the bladder of a girl, aged seventeen. She had passed it into the bladder two months previously.

SHAPE OF CALCULI.

Calculi vary in shape according to their composition and the circumstances of their formation: thus, the uric acid and urate of ammonia are generally oval, the oxalate of lime globular; the phosphatic are generally oval or globular, but they may be of the same shape as their nucleus, or, when large, variously moulded by the contraction of the muscular coats of the bladder upon them.

When several calculi are present in the same bladder they usually present smooth flattened surfaces, in consequence of the attrition of one calculus upon another.

When a calculus becomes lodged at the entrance to the prostatic portion of the urethra it often assumes a dumb-bell shape in consequence of fresh depositions of phosphates upon the part projecting backwards into the bladder.

A calculus impacted in the ureter is generally elongated; a calculus in the kidney is generally branched (see "Calculus in the Kidney").

The following specimens exhibit some of the irregular forms which calculi may assume.

XXXVI. 190.—Sections of a calculus composed principally of phosphate of ammonia and magnesia, and phosphate of lime. At one side there is an appearance as if the calculus had been broken from a pedicle, or narrow base of attachment, and a corresponding impression was derived from a difficulty in extracting it during lithotomy. Near this broken surface the sections show concentric layers of calculous matter which extends half-way only around a nucleus.

XXXVI. 191.—Calculi from a bladder. The two larger, chiefly composed of uric acid, were removed in an operation of lithotomy. The first was crushed in the extraction. The second, extracted entire, is in the shape of a three-sided pyramid, the base and sides of which are all smoothly flattened. The fragments of the first indicate that it may have had nearly the same shape. At the operation it was thought that such a shape would not be acquired unless more than two calculi were present, and subject to mutual contact and friction. Long search was, therefore, made for others; but none existed except two minute rough portions which could have had no share in shaping the larger calculi that were extracted.

XXXVI. 2.—Three small and flattened calculi removed from the bladder of a man, with six others not preserved.

XXVI. 17.—Fifty-three calculi, with flattened, mutually adapted and smooth surfaces. Uric acid nearly pure.

XXXVI. 158.—Twenty-eight small calculi from the bladder of a gentleman sixty-eight years old. Their surfaces are smooth and flat.

XXXVI. 83.—Twelve polyhedral calculi from the bladder.

XXXVI. 42.—Sections of a calculus; mixed phosphates; the dark veins in it probably urate of ammonia. The form of the calculus and the arrangement of its veins appear to indicate that it is composed of two calculi united at their borders.

XXVII. 16.—A bladder and ureters. A small calculus is lodged in each ureter.

XXXVI. 92.—Two lobed calculi from the kidney. Phosphate of lime with a large proportion of animal matter.

XXXVI. 94.—A large lobed and branched calculus from a kidney. Fusible calculus coated with triple phosphates.

COLOUR OF CALCULI.

The colour of a calculus cannot always be depended upon as indicating its chemical composition.

As a rule, however, uric acid calculi are of a nut-brown colour (XXXVI. 164), urate of ammonia of a pipe-clay or ash-grey (XXXVI. 39 and 139), oxalate of lime of a mahogany-brown (XXXVI. 79), phosphatic, white (XXXVI. 42), cystic oxide when preserved, greenish-blue, (XXXVI. 207 and 118), carbonate

of lime, white (XXXVI. 52), xanthic oxide, cinnamon-brown (no specimen).

SPONTANEOUS FRACTURE OF CALCULI.

Calculi sometimes undergo spontaneous fracture; this has been attributed, when there are several calculi in the bladder, to the calculi coming into violent collision with one another, and when there is but one, to the contraction upon it of the hypertrophied muscular coat of the bladder.

The edges of the fragments are generally smooth and rounded off by the friction of the fragments upon one another.

XXXVI. 132.—Calculi, broken into several portions, which were found after death in the bladder of an old man. They had broken spontaneously, and appear to have been parts of several large calculi. The edges of many of the fragments are rounded by mutual friction. They consist of uric acid with a few layers of urate of ammonia.

The patient was eighty-one years old, and had suffered for more than a year with signs of stone in the bladder. He would not allow an instrument to be passed; but on two occasions in the nine months previous to his death he obtained relief from the use of alkaline medicines.

XXXVI. 138.—Fragments of calculi, chiefly impure uric acid. They were passed from the bladder of an old man, and appear to be portions of one or more calculi broken up spontaneously.

XXXVI. 136.—Calculi, urate of ammonia and oxalate of lime in alternate layers, from the bladder of a boy ten years old. The smaller portion was found loose in the bladder, and from the smoothness of its surface it may be presumed to have been spontaneously separated a considerable time before the operation from that part of the larger calculus on which an excavation is now visible.

SITUATION OF THE CALCULI.

The calculus is usually found immediately behind the prostate in the lower fundus of the bladder; but it may be situated in the upper fundus behind the pubes, or lodged in a cyst formed by a pouch-like dilatation of the coats of the bladder or by the protrusion of the mucous membrane between the fasciculi of the muscular coat, or impacted in one of the ureters at its entrance into the bladder, or adherent to the walls of the bladder. Calculous matter is frequently found encrusting morbid growths in the bladder or deposited upon the walls of the bladder when roughened by ulceration of its mucous membrane.

Free, behind prostate. XXVII. 22.—A bladder containing three large calculi situated in the lower fundus, immediately behind the prostate.

In some cases the lower fundus becomes converted into a deep

recess behind the prostate by the dilatation of the coats of the bladder. A calculus lodged in such a recess may escape detection, as happened in the case of the man from whom the following specimen was taken.

Lodged in a deep recess immediately behind the prostate. XXVII. 30.—A bladder, with part of the urethra, of a man on whom the operation of lithotrity was performed. There were two calculi in the bladder, one of moderate size, which was broken by the instrument; the other, of larger size, was not detected by the instrument, being lodged in a deep recess formed by the dilatation of all the coats of the bladder at its lower and back part immediately behind the prostate.

Encysted in a pouch formed by the dilatation of the coats. XXVII. 17.—Sections of a dried bladder, of very large size, and with numerous cysts communicating with the posterior and lateral parts of its cavity. Within two of these cysts calculi are lodged. Fifteen calculi were found in the cavity of the bladder: these, which are arranged by the sides of the sections, appear to be composed of uric acid.

Adherent to the walls of the bladder. XXXVI. 210.—Section of an oxalate of lime calculus that was found at the operation for its removal attached by the end that is placed uppermost in the bottle to the lining membrane of the bladder.

Encysted in a fistulous tract. XXXVI. 47.—A large oval calculus. Phosphate of lime with phosphate of ammonia and magnesia, extracted from a cyst which communicated with a fistulous passage leading from the bladder to the perinæum.

Impacted in the ureters immediately before their entrance into the bladder. XXVII. 16.—A bladder and ureters. The ureters are dilated, and there is a small calculus in each just before its termination in the bladder.

Calculus matter deposited upon the roughened walls of the bladder. XXVII. 38.—The bladder of a girl thirteen years old. Its muscular coat is very thick, strong and fasciculated. Its mucous membrane also is thickened and deeply wrinkled, and the summits of many of the wrinkles are coated with grains of calculus matter. See also XXVII. 36 and XXX. 13, 16.

EFFECTS OF CALCULI (OR OTHER FOREIGN BODIES) IN THE BLADDER.

The long-continued presence of a calculus or other foreign body in the bladder induces serious pathological changes in the urinary organs. Thus, the bladder generally becomes contracted, its mucous membrane thickened, inflamed or ulcerated, and its muscular coat hypertrophied; the ureters become dilated, and their muscular coat hypertrophied; the pelves of the kidneys become dilated, often inflamed (pyelitis), and the kidneys become con-

gested, and inflamed, and their secreting structure destroyed and excavated into a number of cysts.

XXVII. 9.—A bladder containing a calculus, with the ureters and kidneys. The coats of the bladder are thickened, contracted, hypertrophied, and superficially ulcerated. The ureters and the pelves and infundibula of the kidneys are widely dilated.

XXVII. 22.—A bladder, exhibiting hypertrophy of its muscular coat, with enlargement of the prostate, and three large calculi nearly filling the lower half of its cavity, and resting on the enlarged prostate. The ureters open in the narrow interspaces between the calculi.

The walls of the bladder in some cases (as described under hypertrophy and sacculation) become dilated into cysts in which foetid urine collects and in which other calculi are often formed (encysted calculi).

See XXVII. 17.

Ulceration and perforation of the walls of the bladder may occasionally ensue and the calculus escape into the peritoneum, the vagina, the perinæum, or into the rectum, as in the following specimen.

XXVII. 16.—A bladder, contracted, indurated, and thickened, with ulceration extending through the middle of its posterior wall, and forming a passage from its cavity into the rectum. This passage is laid open for the purpose of showing a calculus which is lodged within it. The ureters are dilated, and there is a small calculus in each just before its termination in the bladder. The mucous membrane of the rectum is raised into thick and hard folds. The three calculi at the bottom of the bottle were found in the bladder.

CONGENITAL MALFORMATION OF THE BLADDER.

EXTROVERSION OF THE BLADDER.

Extroversion of the bladder (*ectopia vesicæ*, congenital hiatus of the bladder) is a congenital malformation in which the posterior wall of the bladder is exposed or protruded through an aperture in the lower part of the anterior abdominal walls and front wall of the bladder, the result of the non-union of the ventral laminae in that situation.

The deficiency in the walls of the abdomen and bladder generally reaches as high as the umbilicus, which, in such cases, is absent, and is generally associated with a like deficiency of the upper wall of the urethra, which then appears as little more than a groove along the dorsum of the penis, while the latter organ itself is usually shorter and smaller than natural. The mucous membrane of the bladder appears bright red and villous, and is apt to bleed in consequence of the chafing of the clothes. The

orifices of the ureters, and the urine as it leaves them drop by drop, are visible. A rudimentary prostate, the anterior wall of which is deficient, is generally present, and upon its floor the opening of the common ejaculatory ducts may be seen. The symphysis of the pubis is often absent, the pubic bones being merely bound together by fibrous tissue, while the recti muscles diverge on each side of the bladder to their insertion into the separated pubic bones. The scrotum is generally cleft. The testicles may be found in the cleft scrotum, or they may remain undescended. A congenital scrotal hernia on one or both sides is common. On opening the abdomen the hypogastric artery can be traced over the back of the bladder to the situation of the umbilicus. The urachus is usually absent, or rather the bladder in these cases includes the urachus. The vesiculæ seminales and vasa deferentia are usually well formed.

A. 116A.—The urinary and genital organs, with the front of the pelvis, of a man twenty-one years old, in whom "ectopia vesicæ" existed. The ossa pubis, separated to a distance of an inch and a half, were connected by only a few thin fibrous bands. In the space between them and between the lower parts of the recti abdominis muscles diverging to be inserted in them, and through a corresponding fissure in the other tissues of the abdominal wall, the posterior wall of the urinary bladder protruded its vascular and uneven mucous surface. The orifices of the ureters are here indicated by portions of glass; they are raised on papillæ; the rest of the mucous surface presents the same appearance as during life except in the loss of its vascularity. The penis is an inch and a half in length. The urethra is open from above in its entire length, being indeed little more than a furrow extending along the upper part of the penis to the open cavity of the bladder. The testes are small, but well formed; they lie in a small scrotum; the vasa deferentia have their natural course and relations. The prostate is small and deficient in its anterior part, where the urethra is open. The vesiculæ seminales also are small. The ureters are natural in size and in relations.

A. 227.—A specimen of extroversion of the bladder; an operation for its relief was performed some weeks before death; it failed, but the line of incision still remains, and the portion of integument raised up on the left side of the bladder is much contracted.

Two black rods are placed in the ureters, two bristles in the vasa deferentia, and a third bristle in the sinus pularis; there is no symphysis pubis, the two pubic bones being separated by an interval of an inch and a quarter. The recti muscles are separated by the bladder. Nevertheless the ossa innominata present a normal appearance, all the parts being present. The ilia, however, seem to be articulated at a more obtuse angle than usual with the sacrum. The obliterated hypogastric arteries can be seen crossing the pelvis. The umbilicus is well marked, but no distinct urachus was made out. The skin of the

scrotum is left. The testes, which were normal in appearance and position, have been removed. The vesiculæ seminales are present, and of normal size.

INJURIES AND DISEASES OF THE KIDNEYS.

RUPTURE OF THE PELVIS OF THE KIDNEY.

XXVI. 14.—A kidney, in the pelvis of which there is a circular aperture, communicating with a very large sac. A part only of this sac is preserved. It was situated behind the peritoneum, and extended forwards from the region of the kidney to the anterior wall of the abdomen: its walls were formed of cellular tissue thickened and indurated, and it contained pus mixed with urine. A portion of glass is passed through the aperture in the pelvis of the kidney into the sac; and another portion is passed through the ureter, which runs for a considerable distance in the substance of the walls of the sac, and then opens into its cavity at a distance of about two inches from the aperture in the pelvis. The kidney itself appears healthy.

The patient, a woman forty years old, was knocked down by a cart; her left thigh was fractured, and she received some injury in the right hypochondrium. The next day there was much swelling and tenderness of the abdomen; but the swelling gradually subsided, and there remained a circumscribed hard tumour in the region of the liver, which increasing and appearing to contain fluid, was punctured about three weeks after the accident. Between two and three pints of urinous fluid were withdrawn. Ten days afterwards, six pints of a similar fluid were withdrawn; but it again accumulated, and the patient died exhausted ten weeks after receiving the injury. The preparation proves that the pelvis of the kidney had been ruptured, so as to permit the passage of urine into the adjacent cellular tissue, which urine, as it accumulated, was circumscribed by the thickening and induration of the tissue into the form of a sac.

Calculus in the kidney.

XXVI. 8.—A kidney, the pelvis and infundibula of which are dilated and filled with calculi. One large calculus fills the pelvis, and branches from it are continued into many of the infundibula. Smaller calculi fill the other infundibula. The glandular substance of the kidney is nearly absorbed.

XXVI. 9.—A kidney, with a large calculus impacted in the commencement of the ureter. The kidney is much increased in size, and its substance appears indurated, and in parts, infiltrated with pus. The pelvis and infundibula are greatly dilated, and their mucous membrane is thickened and made rough by the copious deposit of inflammatory material upon its surface. See also XXVI. 16.

Lodgment of a calculus at the commencement of the ureter. Ulceration extending from the pelvis of the kidney into the colon. XXVI. 5.—A kidney, which is much enlarged in consequence of the lodgment of a

calculus at the commencement of the ureter. The infundibula are dilated; their mucous lining and the proper substance of the organ are indurated, and appear to be the seat of purulent deposit. Portions of glass are introduced through the ulcerated apertures leading directly from the kidney to the descending colon. The portion of the colon which thus communicates with the interior of the kidney exhibits numerous small ulcers of its mucous membrane. The capsule of the kidney, a part of which is reflected, is thickened, indurated, and consolidated with the surrounding tissues.

The patient was a young man who had suffered from attacks of pain in the loins, which were always relieved by discharges of pus from the rectum. A quantity of pus was found also to have passed from the lower part of the kidney to the back of the psoas muscle.

XXVI. 37.—A kidney, in the pelvis of which are large and irregular calculi. The inflammation and suppuration which ensued were followed by adhesion of the kidney to the adjacent portion of the descending colon, and the discharge of the contents of the pelvis into the intestinal canal through an ulcer.

Blocking up of the pelvis of the kidney with soft calculous material.

XXVI. 17.—Section of a kidney, in which nearly the whole of the glandular structure is absorbed. In its place, and in the pelvis and ureter, there is a soft and white substance, like mortar, consisting of phosphate of lime, with small proportions of carbonate of lime and of animal matter. From a woman, sixty-two years old, who for twelve years before her death had no sign of renal disease.

Renal calculi.

XXXVI. 214.—A renal calculus taken from the body of a middle-aged lady. The calculus consists of pure oxalate of lime of the crystalline and dumb-bell varieties.

XXXVI. 215.—A renal calculus, composed of cystic oxide, from a man. The bright shining particles on its surface consist of small flakes of cholesterine. See also XXXVI. 92, 93, 94, 112, 168, 230.

CHAPTER XIV.

DISEASES OF THE BREAST.

THERE are no specimens of hypertrophy, of inflammation, or of abscess of the breast in the Museum.

SIMPLE CYSTS.

Simple or serous cysts of the breast are nearly always solitary. They occur as completely closed sacs embedded in the substance of the gland, having no connection with the ducts. They have thin delicate walls lined with squamous epithelium and contain a serous fluid, which generally reaccumulates after it has been drawn off. They are probably formed by the expansion and fusion of the intertubular connective tissue spaces.

XXXXIV. 3.—Portion of a mammary gland, in which is embedded a simple thin-walled cyst, with a smooth and polished internal surface. The cyst was filled with a clear fluid.

MILK CYSTS OR GALACTOCELES.

Galactoceles are produced either by the dilatation of an obstructed duct, or by the rupture of a duct and extravasation of the milk into the intertubular connective tissue, which becomes condensed around it to form a capsule. They appear as one or more round or oval swellings in the substance of the gland, and generally contain a milk-like fluid, or when, as sometimes happens, the watery parts of the milk have been absorbed, an inspissated mass of oily, caseous material.

XXXXIV. 33.—A cyst, the contents of which resembled inspissated milk. It was removed from the mammary gland of a young woman, where it had existed for eighteen months, without any material augmentation of its size.

XXXXIV. 31.—A cyst, removed from a breast in which it lay deep within or behind the mammary gland. It was of nearly spherical shape, thin-walled, and loosely connected with the adjacent parts. Its inner surface, now everted, is nearly smooth, polished, and of a pale

brown colour. Some small portions of a white fatty substance like spermaceti adhere to it.

XXXIV. 32.—The greater part of the contents of the cyst last described, viz. about three ounces of a creamy, pale-fawn coloured liquid, with small white particles floating in it. It resembles the fluid contents of certain sebaceous cysts.

PROLIFEROUS CYSTS.

Proliferous cysts, or cysts containing solid growths, will be found described under Sero-cystic Sarcomas (page 425).

MAMMARY GLANDULAR TUMOURS.

The group of tumours called by Sir James Paget mammary glandular, and by Mr. Birkett adenocoeles, are by more recent writers, and especially by the continental pathologists, divided into several distinct classes according to their histological structure. The term mammary glandular has, however, here been retained, as although many of the tumours thus named differ from one another in their minute structure, they all agree in bearing a general resemblance to normal gland tissue, and in being generally innocent and capsulated. The term, moreover, is one by which the several varieties of these glandular tumours have long been recognised by practical surgeons.

Mammary glandular tumours occur as one or more distinct circumscribed growths in the substance of the gland. They are usually of a round or oval shape, firm, elastic, lobulated on the surface, movable, and surrounded by a capsule of connective tissue, from which the growth can be readily shelled out. The capsule is sometimes smooth and shining upon its internal surface, and is sometimes separated from the growth by a small quantity of serous fluid; such cases have led to the supposition that the capsule is really the wall of a cyst, and that the tumour is a secondary formation which has grown into and filled the cavity of the cyst. Mr. Birkett believes that this appearance of a growth projecting into a cyst is often due to the separation of the capsule by fluid.

The tumours on section generally appear lobular and of a yellowish-white colour, sometimes with a purplish tinge. The section does not become concave as in scirrhus, and when scraped it does not yield a cancer juice.

The lobular appearance of the section, as pointed out by Sir James Paget, suggests that these tumours, in many instances, consist of a number of proliferating intra-cystic growths; actual cysts are often laid open on section.

Mammary glandular tumours are of slow growth and usually of

small size, but they may attain large dimensions, when they occasionally ulcerate and protrude through the skin in the form of a fungus. They are nearly always innocent, they do not affect the corresponding lymphatic glands and distant organs as cancer does, nor do they commonly return when removed; they have occasionally, however, after removal been followed by malignant growths (cancer or sarcoma). They generally occur in young women.

In minute structure they differ widely. They commonly consist of a greater or less proportion of tissue resembling that of the healthy mammary gland, combined with a new growth consisting of fibrous, sarcomatous, or myxomatous elements in the inter-tubular connective tissue. In many instances it is impossible to determine whether the gland tissue is newly formed or is merely the remains of the original gland tissue embedded in the new growth. According as the sarcomatous, the myxomatous, or the fibrous elements prevail, the tumour is designated adeno-sarcoma, adeno-myxoma, or adeno-fibroma. In rare cases the tumour is composed of gland tissue alone without any admixture of other elements (true adenoma).

Mammary glandular tumours frequently contain a number of cysts which often attain a large size, and into which proliferating masses of the growth appear to project. The cysts are formed in different ways: the smaller cysts are generally produced by the degeneration of the tumour elements, by the breaking down of blood-clots, or by the enlargement of some of the intertubular spaces. The cysts containing growths are probably formed by the dilatation of ducts, and, as pointed out by Mr. Birkett, by the accumulation of fluid between the capsule and the growth.

In some instances the whole tumour appears to be developed in a cyst. The growths are then designated cystic adeno-sarcomata, cystic adeno-fibromata, &c., according to the structure of the intracystic growth, and are included in the group of tumours designated by Sir Benjamin Brodie "sero-cystic sarcomas." In Sir James Paget's lectures on "Surgical Pathology" these tumours are described as proliferous cysts.

The specimens of mammary glandular tumours are here classed according to their histological characters.

Adeno-fibroma.

XXXIV. 23.—A small tumour removed from the breast. It is of oval form, nodulated on its surface, and invested by cellular tissue forming a distinct capsule. Its substance is tough, elastic, nearly opaque-white, appearing obscurely and very closely filamentous. There is a small smooth-walled cyst in its centre, and it is incom-

pletely partitioned by fibrous bands. From a married lady thirty-six years old, in whom it had grown slowly, and almost without pain, for four years. The tumour consists of gland tissue with much loose fibrous tissue. A section of the growth is preserved in the Microscopical Cabinet (A. 37).

XXXIV. 24.—Section of a breast and of a large tumour developed in the mammary gland. The tumour is spheroidal in form, and nearly three inches in diameter. It is composed of a very firm, compact, greyish substance, traversed by numerous undulating, white, fibrous bands. Microscopically the tumour consists of fibrous tissue, with a small amount of gland tissue. A section is preserved in the Microscopical Cabinet (A. 38).

XXXIV. 37.—A chronic mammary glandular tumour, very distinctly lobulated, removed from the right breast of a girl aged eighteen. It was discovered six months before the operation. It is partially divided by a vertical section. Microscopically it consists of fibrous tissue, with a small amount of gland tissue. A section of the tumour is preserved in the Microscopical Cabinet (A. 39).

Adeno-myxoma.

XXXIV. 22.—A small tumour removed from the breast. It is of oval form, nodulated on the surface, and invested by cellular tissue forming a distinct capsule. It is composed of a soft, elastic, semi-transparent, glistening substance, traversed by opaque-white, undulating fibres, of which the larger appear on the section to form partitions dividing it into several round masses.

From a woman twenty-five years old, in whom it had been growing two years, and had occasionally been the seat of severe pain.

Microscopically the tumour appears to be of the nature of an adeno-myxoma, but the characters of the tumour have been rendered somewhat indistinct by the length of time the specimen has been preserved in spirit. A section of the tumour is contained in the Microscopical Cabinet (A. 40).

Adenoma.

XXXIV. 18.—A portion of a very large tumour, which was removed with a woman's breast. It is composed of an elastic, tough, white, homogeneous substance, arranged in closely connected lobes. The whole tumour was of an oval form, and weighed seven pounds. The patient was between thirty and forty years old. The tumour had been growing thirteen years, and produced little inconvenience, except by its weight. She used to sit with the breast resting upon her knees until the integuments began to slough. The mammary gland lay under the tumour, and appeared healthy. The patient recovered completely after the operation.

Under the microscope the tumour is seen to consist principally of gland tissue, with a small admixture of fibrous tissue. A section is preserved in the Microscopical Cabinet (A. 41).

There are no specimens of adeno-sarcoma in the Museum.

SARCOMATOUS TUMOURS.

Specimens of pure sarcomatous tumours in the breast are rare; the sarcomatous elements being nearly always intermixed with a greater or less amount of newly-formed gland tissue (adeno-sarcomata).

All varieties of the sarcomata, however, occasionally occur. Of these the spindle-celled sarcoma (the recurrent fibroid tumour of Paget) is the most common.

Spindle-celled sarcomata somewhat resemble the mammary glandular tumours; their section, however, is smooth and uniform, and does not present a lobulated or fibrous appearance. They may attain a large size, and return after removal, the subsequent growths generally being softer. They do not affect distant organs.

Round-celled sarcomata resemble either mammary glandular tumours or medullary cancer, from which it is often impossible to distinguish them except by the microscope. They are generally softer than the mammary glandular tumours, and the lymphatic glands are not affected as they are in cancer. They return on removal, and affect distant organs. Cysts are frequently developed in them, and they sometimes appear as intra-cystic growths, when they constitute one form (the malignant) of the sero-cystic sarcomas of Brodie.

A specimen of round-celled sarcoma which occurred after the removal of a pigmented round-celled (melanotic) sarcoma follows.

XXXIV. 25.—A tumour, exactly resembling in external appearance that in No. 24. It separated by sloughing from the breast of the same person.

The patient was an unhealthy woman, forty-seven years old. The tumour in No. 24 had existed many months, and, after an accidental blow, had grown fast and with much pain for seven weeks before the removal of the breast. About three months after the operation, when the wound had been long healed, the tumour in No. 25 began to grow under the cicatrix. It increased rapidly, and in about three months, the integuments over it having ulcerated, it was completely separated by sloughing. The cavity left by its separation ulcerated widely and deeply, and the patient died exhausted nine months after the removal of the tumour. Hard white tumours, of sarcomatous appearance, were found in the lungs. Some of them are in XIV. 43; and part of the patient's stomach is in XV. 24.

Microscopically the tumour has the structure of the round-celled sarcomata. A section is preserved in the microscopical cabinet (A. 42).

XXXIV. 10.—Section of a mammary gland, exhibiting the deposit of melanotic sarcoma, both in small round masses and in a more diffuse form.

From a young woman in whom the primary disease had its origin in a mole, or dark *nævus*, on the back, which had passed into a melanotic sarcoma a few months only before its removal. The patient died, about two years after the operation, with melanotic sarcomata in nearly every organ. The primary growth is contained in XXXV. 23; the bones in I. 190, 191, 192; the dura mater in VI. 55; the portion of liver in XVIII. 26; and the ovaries in XXXI. 16.

Myeloid sarcomata in the breast are very rare. The following specimen has the characters of a typical example of myeloid sarcomata occurring in bone.

XXXV. 109.—Part of a mammary gland, including a section of tumour embedded in its substance. The tumour is oval, circumscribed, and closely connected with the substance of the gland, though separable from it, and invested with a thin capsule. Its consistence is firm and tough; its cut surface smooth, uniform, with no appearance of lobes, or fibres, or other distinct texture; in the recent state greyish, with a yellowish-green tinge, and in parts suffused with a deep crimson, bloody hue. Its minute structures were, partly, cells with large clear nuclei, like those of medullary cancer, and, partly, many nucleated, oval, flask-shaped, and other bodies like those of myeloid tumours. The general aspect of the tumour also bore much resemblance to that of the myeloid growths.

The patient was forty-five years old. The tumour had been observed for four months. She recovered favourably from the operation for the removal, but five years afterwards scirrhus cancer began to form in the part of the breast left in the operation. (A sister of the patient was at the same time in the hospital with scirrhus cancer of the breast.) In a second operation the cancer and all that remained of the breast were removed, and the patient continued free from apparent disease for nearly two years, when a tumour began to form in the other (right) breast. This being removed was found to be a growth like the specimen here preserved, except in that it had a large central cavity filled with blood-coloured fluid. The woman was in good health six years after the last operation. The recent appearance of the tumour is shown in a drawing, No. 184.

MYXOMATOUS TUMOURS.

Tumours having the microscopical characters of the myxomata occasionally occur in the breast. They vary greatly in their physical characters, but can generally be recognized by their soft, semi-transparent, gelatinous appearance on section. They generally contain cysts. Pure myxomatous growths are innocent, but the softer forms are liable to recur after removal. A good specimen presenting a typical microscopical structure follows.

XXXIV. 2.—Section of a tumour, which weighed eight pounds, and occupied the situation of the mammary gland. The outer surface of

the tumour is uneven, knobbed, and appears to have been loosely connected with the adjacent parts. Its section shows that it is composed of a light grey semi-transparent substance, compact and glistening on the cut surface, and variously intersected by slender bundles of fibres. A few small cysts, with polished internal surfaces, are scattered in the substance of the tumour, and at the lower part of the section are appearances as if such cysts had been filled by lobulated growths from their walls.

The tumour has the microscopical characters of the myxomata. A section of it is preserved in the Microscopical Cabinet (A. 43).

FIBROUS TUMOURS.

Fibrous tumours in the breast are rare. They resemble the fibromata in other situations. They are usually of a globular shape, capsulated and fibrous on section. They are perfectly innocent, and must not be mistaken for the atrophic variety of scirrhous cancer. A good specimen follows.

XXXIV. 40.—Fibrous tumour of the mammary gland, through the substance of which are scattered numerous small cysts. From a woman, aged forty, who had been aware of the existence of a tumour in the breast for only five weeks previous to the operation. The whole substance of the tumour is composed of simple fibrous tissue.

CARTILAGINOUS TUMOURS.

Cartilaginous tumours of the breast are extremely rare. The following is a specimen of a cartilaginous tumour from the mammary gland of a bitch.

XXXIV. 13.—An oval nodulated tumour, consisting of a mixture of cartilage and bone, which was removed from the mammary gland of a bitch.

SERO-CYSTIC SARCOMAS.

The group of tumours called sero-cystic sarcomas by Sir Benjamin Brodie, and included by Sir James Paget under the head of proliferous cysts, have, by recent writers, been distributed amongst the various cystic tumours (cystic-adeno-fibroma, cystic-sarcoma, cystic-carcinoma), according to their histological structure. Although differing in their anatomical structure, they all appear to be developed in the interior of a cyst which has been formed by the dilatation of a duct or in some other way. "From the inner surface of such a cyst," says Sir James Paget, "a vascular growth may spring, and as this considerably increases at a rate beyond that of the increase of the cyst it fills more and more of the cavity. At length the growth wholly excludes the fluid contents of the cyst, and its sur-

faces come in contact with the remainder of the cyst walls. The growth may now coalesce with the walls of the cyst and form one solid tumour, enclosed in and connected with them, just as ordinary solid tumours are invested and connected with their connective-tissue capsules. Or, growing yet further and more rapidly, the growth, hitherto intra-cystic, may protrude through its cyst-walls and the subjacent integuments, protruding through them as a hernia of the brain does through the skull, growing exuberantly over the adjacent skin, and like such a hernia, reproduced when cut away."

The manner in which the tumour is supposed to grow into and to gradually fill the interior of the cyst is well illustrated in the following series of specimens. As the intra-cystic growths in these specimens, however, differ in histological characters, the specimens are also described under the tumours which they histologically resemble.

XXXIV. 1.—A breast, with two cysts embedded in it. The walls of the cyst are thin and tough, and they communicate by a small aperture. The larger cyst was distended by a watery fluid, and a lobulated growth has arisen from a part of its inner wall. The microscopical characters of the growth are those of medullary carcinoma.

A section is preserved in the Microscopical Cabinet (A. 44).

XXXIV. 7.—Part of a breast, in which a cyst, with rather thick tough walls, is embedded in the mammary gland. A round lobulated mass of soft substance has grown from a portion of the inner wall of the cyst; the rest of its cavity was filled with serous fluid. The microscopical characters of the intra-cystic growth are those of medullary carcinoma. A section of the growth is contained in the Microscopical Cabinet (A. 45).

XXXIV. 16.—A breast removed from a middle-aged woman. The situation of the mammary gland is occupied by a large cyst, which contained a serous fluid, and around which the gland is spread out. The walls of the cyst are about a line in thickness, tough, but pliant; its interior is irregularly wrinkled and somewhat sacculated; a small, soft, lobulated growth projects from a portion of its wall into its cavity. Above this cyst (at a part of the mammary gland which during life lay near the axilla) is a small oval mass of hard cancer, with irregular cavities, the result apparently of its partial softening. The patient died some time after the removal of the breast with a return of the cancerous disease. The microscopical structure of the intra-cystic growth is that of Medullary Carcinoma.

A section is contained in the Microscopical Cabinet (A. 46).

XXXIV. 21.—A breast, in which a cyst is embedded in the mammary gland. The cyst has the same general characters as those in Nos. 1, and 16, but its cavity is almost filled by a soft, lobulated, and vascular growth attached by a broad base to a large portion of its wall. It is loosely connected with the adjacent parts. The mammary gland is very small.

The breast was removed from a woman forty-nine years old. The cyst had been increasing slowly and with very little pain for between four and five years. She recovered from the operation.

On microscopical examination the intra-cystic growth is seen to consist of medullary carcinoma.

A section of the growth is preserved in the Microscopical Cabinet (A. 47).

XXXIV. 11.—A mammary gland, with two tumours embedded in it, which were removed by operation. Each tumour is circumscribed and surrounded by a distinct capsule of cellular tissue. The substance of each tumour appears to consist of separate portions loosely connected by cellular tissue, which in the recent state resembled the lobules of the pancreas. The arrangement of the lobules indicates that they are growths (such as are in Nos. 1 and 7) which have arisen from the walls of numerous cysts, and have now filled their cavities, become firm, and coalesced with the cyst-walls so as to form a nearly solid mass.

On microscopical examination the growths are seen to consist almost entirely of fibrous tissue.

A section is preserved in the Microscopical Cabinet (A. 48).

XXXIV. 19.—Section of a woman's breast, and of a tumour seven pounds in weight, of which a part protruded through the ulcerated skin. The lower part of the tumour presents a section of a large cyst, with thick, soft succulent walls, which contained a pale yellowish fluid. Above this the substance of the tumour is soft, elastic, somewhat glistening and jelly-like: the greater part of it protruded through the skin in the form of a deeply-lobed and very vascular mass, the surface of which was covered by healthy-looking granulations, and appeared to be in parts *skinned over*. The appearance of the tumour had been altered by a ligature tied round the base of the protruded part some time before it was removed; it is from this that the margins of the protrusion appear to overhang so far the surface of the surrounding integuments.

The microscopical characters of the tumour are somewhat obscure in consequence of the length of time the specimen has been preserved in spirit. It consists of connective tissue infiltrated with closely-set small round cells. It is probably a small-round-celled sarcoma.

A section of the growth is contained in the Microscopical Cabinet (A. 49).

XXXIV. 41.—A portion of a sero-cystic sarcoma of the breast. On the surface of the section a large cyst is seen, almost filled by intra-cystic growth.

The disease occurred in a woman, aged sixty-six, and had existed for twelve years, during the last six months of which it had rapidly increased from the size of a fist to that of a child's head.

On microscopical examination the growth is seen to consist of a fibrous stroma, the alveoli of which are infiltrated with epithelial-like cells. (Hard carcinoma).

A section of the growth is preserved in the Microscopical Cabinet (A. 50).

SCIRRHOUS CANCER.

Scirrhus is the most common form of cancer in the breast. It generally begins as a small nodular mass in the substance of the gland, and after growing slowly for some time invades the whole breast and surrounding adipose tissue. The cancerous mass becomes adherent to the skin and pectoral muscles; the lymphatic glands in the axilla and mediastinum, and afterwards those in the neck, become enlarged, at first from irritation only, afterwards from deposits of cancer in their interior; the skin gives way, and a foul cavernous ulcer, or a protruding fungating mass is produced. The arm and side of the chest become œdematous and swelled in consequence of the pressure of the enlarged axillary glands upon the blood-vessels; distant organs become affected, especially the lungs, pleuræ, and peritoneum; cancerous cachexia sets in, and the patient dies in consequence of exhaustion, or of repeated hæmorrhages due to the ulceration extending to the arteries supplying the cancerous mass, or of intercurrent pleurisy or peritonitis, or of some other affection of distant organs. Such is the common course of scirrhus cancer. Variations of this course are, however, not infrequent. Thus, the cancer may begin as a general infiltration of the whole gland, in which case it is usually very rapid in its course. In some instances the skin is chiefly affected, the whole side of the chest in such a case appearing hard, brawny, infiltrated, and leathery in consistence. In rare instances, again, it may begin as an infiltration of the nipple; or, as pointed out by Sir James Paget, it may follow upon chronic eczema of the nipple, when it is believed by Mr. Butlin to be due to the eczematous inflammation spreading along the ducts. In old women the cancer may be very chronic, remaining stationary, if not interfered with, for many years. Moreover, the cancerous mass has at times undergone complete atrophy, and, even after ulceration has occurred, healing of the ulcer and atrophy of the mass have been known to ensue.

Pathological appearances.

Scirrhus cancer generally appears as a hard nodular mass, non-capsulated, with processes extending in all directions in the gland substance, and in the adipose tissue around. The nipple is usually retracted in consequence of the lacteal ducts being drawn inwards, in common with other tissues, by the contraction and shrinking of the cancerous mass. In some cases, however, the nipple instead of appearing retracted, appears more prominent than usual and hard and rigid owing to its early infiltration with the cancer. The skin,

in consequence of the above-mentioned traction upon the tissues surrounding the cancerous mass, frequently appears dimpled, *i.e.* drawn inwards in places, some time before it has become infiltrated with the cancer.

On making a section of the tumour a peculiar creaking sensation is experienced, and "the cut surface becomes slightly concave, sinking in towards its centre through the persistence, I suppose," says Sir James Paget, "of that tendency to contraction to which during life we have to ascribe the traction of the surrounding tissues, and which is now no longer resisted by them." The section generally appears greyish white, sometimes with a pinkish tint, semi-transparent, firm, and of uniform close texture, often intersected (as in No. 14), in every direction, by short, wavy lines, like bundles of white fibres, which mingle together in a close, irregular network, by which it is sometimes (as in No. 5) imperfectly divided into lobes. Sometimes (as in No. 28) it presents round or oval orifices, the section of lactiferous tubes involved in it, or it may be dotted with small, yellow spots (as in No. 98), the contents of the tubes which have been cut across, or with patches of yellow due to fatty degeneration of the cancer-cells, consequent upon the pressure exerted upon them by the contraction of the fibrous stroma. The fatty degeneration of the cellular elements likewise frequently leads to the formation of cysts. When scraped the section yields a juice containing nucleated cells, free nuclei, and granular material.

On microscopical examination the cancer is seen to consist of a fibrous stroma, the alveoli of which are infiltrated with epithelial-like cells, amongst which are seen a number of small, round cells.

Some differences of opinion exist as to whether the cancer begins in the acini, or in the connective tissue around, or in both situations. Those observers who maintain that all cancers are epithelial in origin, believe that it begins by a proliferation of the epithelium lining the acini, and that the small-celled infiltration always observed in the intertubular connective tissue is a secondary change. Others, however, maintain that the connective tissue is the structure primarily affected.

XXXIV. 14.—Section of a breast and of a large hard cancerous tumour embedded in it. The nipple is retracted to the surface of the tumour, and appears sunk in a deep pit in the integuments of the breast. The cancerous structure exhibits a pale dull-greyish basis, shaded with light pink, and intersected in every direction by short wavy lines, like bundles of white fibres, which mingle together in a close irregular network. This fibrous structure is most distinct about the centre of the mass; its exterior appears more homogeneous: its whole substance was almost incompressibly hard. The surface of the

tumour is closely united to the surrounding tissues: its outline is irregular, small lobes extending from its surface into the adjacent fat.

From a woman sixty years old.

XXXIV. 30.—Sections of a mammary gland, the whole of which is occupied by scirrhus cancer. In the upper specimen one half of the gland is shown dissected from the parts around it; in the lower, the other half is embedded in the surrounding fat. The former specimen shows that the shape of the gland is retained, even while its structure, with the exception of little more than its larger ducts, are replaced by cancer structures forming an intensely hard and compact substance. The latter specimen shows especially the deep retraction of the cancerous nipple, the small size of the cancerous mammary gland, the branching of its larger ducts, and the abundant fat around them.

The patient was about fifty years old. The disease had probably been in progress for about six months before its removal. It recurred in two years and three quarters, and she died rather more than three years after the operation.

Chronic scirrhus cancer. **XXXIV. 5.**—A tumour with a portion of skin removed from a breast. The tumour is nearly spherical, and appears to have been slightly connected with the surrounding parts. It is of pale, firm, and uniformly close texture, and is intersected by fine undulating fibres, like partitions imperfectly dividing it into lobes.

Microscopically the tumour presents the characters of scirrhus cancer.

A section is preserved in the Microscopical Cabinet (A. 51).

XXXIV. 28.—A mammary gland, in the mid-substance of which is a well-marked example of chronic scirrhus cancer. The cancerous mass is small, flattened, oval, very hard and compact; it was greyish and dry. On its cut surface it shows some branching white lines and oval orifices, the sections of lactiferous tubes involved in it. It is very closely connected with the surrounding structures, but a portion of them is removed to show its nodulated surface.

XXXIV. 8.—Sections of a tumour removed from the breast of an old woman. The structure appears similar to that of No. 5. It had grown very slowly.

Microscopically the tumour has the structure of scirrhus cancer.

A section is preserved in the Microscopical Cabinet (A. 52).

Acute scirrhus cancer. **XXXIV. 29.**—Section of a mammary gland with a well-marked example of acute scirrhus cancer. The whole breast appears to have been large. The cancerous mass, of large size and oval form, occupies the greater part of the gland, and is embedded on the surface of the pectoral muscle. The section of the cancer shows a texture much less compact and dense than that of the preceding specimens, and varied in aspect by the intermingling of the white-lobed portions of the mammary gland involved in the cancerous infiltration. A section of a similarly cancerous lymphatic gland is suspended above the section of the breast.

XXXIV. 12.—Section of a breast, and of a small hard cancer

situated just below the nipple. The part of the tumour nearest to the skin has softened, and exhibits on its section a small irregular cavity, which was full of grumous semifluid substance. There are smaller and less completely softened spots in other parts of the tumour. The skin and other tissues are healthy, but the nipple is retracted.

From a lady between forty and fifty years old. The disease returned before the wound of the operation had completely healed.

Characters of the cancerous ulcer.

It has already been stated that the cancer, if not removed, becomes adherent to the skin, which structure finally gives way and a cancerous ulcer results. The ulcer may be superficial, or deeply and irregularly excavated, and covered with a sanious, foul-smelling discharge; the skin around is adherent, and infiltrated with nodules of cancer. The appearances of the ulcer are well seen in the following specimen.

XXXV. 98.—Section of a scirrhus cancer in a woman's breast. The cancer structures occupy the whole mammary gland, and much of the skin over it, and protrude through the skin with a deeply ulcerated surface. The section through the substance of the cancer shows a firm, close-textured, white substance, well defined, intersected by short, branching white lines, and dotted with what appear to be orifices of lactiferous tubes filled with a yellowish material. The ulcerated surface is deeply and unequally excavated, and coarsely nodular; its border is elevated, slightly everted, sinuous, and in part surrounded by nodules of the cancerous substance elevating and thinning the adjacent skin.

The patient was fifty years old when the disease commenced. After nearly two years of painless progress and four months of ulceration it was removed with the breast, and some diseased axillary glands. Within three months after the operation small cancerous tubercles began to form in the skin about the scar, and in twenty months the patient died.

In very rare instances the cancer, even after ulceration has occurred, may undergo atrophy and the ulcer partially heal or skin over. Such healing occurred in the following specimen.

XXXV. 110.—A scirrhus cancer of the breast, in which, after the disease had been six or more years in progress, and had ulcerated and protruded through the integuments, it ceased to increase, and shrivelled and partially healed. It appears now as a dry, lobed mass, closely fixed to the ribs and intercostal muscles.

Effects of treatment with pernitrate of mercury.

XXXIV. 36.—A sloughing cancerous mass from the breast of a woman, aged fifty-nine, in whom it had existed for two years. The

skin over the breast was first destroyed by acid permanganate of mercury, and chloride of zinc was afterwards applied to the sloughing surface of the cancer, at intervals of a day or two. The whole process lasted about a fortnight, and the present slough was separated about four weeks from the first application of the caustic.

Scirrhus cancer of the male breast.

XXXIV. 26.—Section of a man's breast, with scirrhus cancer of the whole mammary gland. The cancer forms an irregular rounded mass nearly two inches in diameter; it is intensely hard, pale-greyish, with branching white lines, and small yellow spots. It has extended to that part of the skin which is stretched tensely over it, and to the nipple, which is depressed and enlarged on the centre of its surface. At its deepest part, fibres of the great pectoral muscle are included in its surface.

The patient was forty-eight years old, of healthy aspect. He had observed the disease for six months. It had increased quickly, and had been painful for two months. Two axillary glands were similarly diseased, and were removed with the breast. The patient recovered from the operation.

A drawing (315) shows the appearance of the disease when recent.

XXXIV. 35.—Ulcerated scirrhus cancer of the left male breast, removed from a man aged forty-one. The disease had existed eighteen months. Some large cancerous glands were removed from the corresponding axilla.

XXXIV. 38.—Scirrhus cancer of the right mammary gland, removed from a man aged sixty-two. It had existed for twelve months. Five or six enlarged and indurated glands, in which, however, no cancer structure could be detected, were at the same time removed from the axilla. The tumour forms a circumscribed oval mass, surrounded by adipose tissue.

MEDULLARY CANCER.

Medullary cancer in the breast is far less common than scirrhus. It occurs as a soft, rapidly growing tumour in the substance of the gland, and speedily involves surrounding parts and protrudes through the skin as a fungating mass of bleeding cancer. It appears, in some instances, to originate in the interior of cysts. Indeed, many of the intra-cystic growths described in the catalogue as sero-cystic sarcomas, have the microscopical characters of medullary cancer. See XXXIV. 1, 7, 16, 21.

XXXIV. 6.—A tumour removed from a breast. It consists of a close-textured medullary substance, and in its lower part were small cysts full of blood.

XXXV. 28.—A large tumour with the surrounding skin, removed from the front of the chest of a middle-aged lady. The section of the tumour shows that it is composed of a soft but compact, pure white,

brain-like medullary substance, with blood diffused through its lower half.

In the course of eleven years preceding the removal of this tumour, three similar operations had been performed on the same lady. At the first operation, the part removed appeared to be a simply hypertrophied mammary gland. At the second, a large tumour was removed from the opposite breast. At the third, a large tumour removed from the seat of one of the former operations appeared to be partly fibrous and partly medullary. At the fourth, the tumour above described was removed from the front of the sternum between the cicatrices of the other operations. The effusion of blood into the lower part of this tumour was the consequence of its being punctured. Profuse hemorrhage occurred at the same time, and a large portion of the tumour, as the preparation shows, protruded through the wound.

XXXV. 29.—Sections of a tumour, with the surrounding skin, removed from the same patient as the tumour last described, and from the situation of the cicatrices of the previous operation. The sections display the same medullary character as the preceding tumour presents, but the morbid substance is softer and more uniformly coloured with effused blood.

During her recovery from this, the fifth, operation, the patient died suddenly. A mass of fibrine, mixed with cancerous matter, was found in the pulmonary artery. See XIII. 100.

COLLOID CANCER.

Colloid cancer of the breast is rare ; a good specimen follows.

XXXIV. 39.—Portion of the breast of a woman, aged forty, with a mass of colloid cancer in its substance. The tumour had been growing for two years and a half before its removal.

LIST OF WORKS REFERRED TO.

PAGE

10. **BAKER, Mr. W. Marrant.** Medico-Chirurgical Transactions, vol. lx.
12. **PAGET, Sir James.** Medico-Chirurgical Transactions, vol. lx.
- „ **COOPER, Professor Samuel.** First Lines of the Practice of Surgery.
31. **BAKER, Mr. W. Marrant.** Medico-Chirurgical Transactions, vol. lx.
37. **PAGET, Sir James.** Lectures on Surgical Pathology.
42. **CORNIL et RANVIER, MM.** Manuel d'Histologie Pathologique.
53. **PAGET, Sir James.** Lectures on Surgical Pathology.
59. **CORNIL et RANVIER, MM.** Manuel d'Histologie Pathologique.
- „ **WILKS and MOXON, Drs.** Pathological Anatomy.
- „ 66, **BILLROTH, Professor Theodor.** Die allgemeine chirurgische Pathologie und Therapie.
74. **SAVORY, Mr.,** in Lawrence's Lectures on Surgery.
- 82, 85. **PAGET, Sir James.** Lectures on Surgical Pathology.
91. **ADAMS, Dr. Robert.** On Rheumatic Gout.
- „ **SMITH, Professor.** On Chronic Rheumatic Arthritis of the Shoulder-Joint. Dublin Quarterly Journal, May, 1855.
- „ **MARSH, Mr. Howard.** St. Bartholomew's Hospital Reports, vol. iv.
96. **CALLENDER, Mr. G. W.** St. Bartholomew's Hospital Reports, 1865.
101. **PIEBIE, Professor.** Practice of Surgery.
- 108, 109. **SMITH, Professor R. W.** Treatise on Fractures in the Vicinity of Joints, &c.
126. **CORNIL et RANVIER, MM.** Manuel d'Histologie Pathologique.
- 127, 128, 129. **BILLROTH, Professor, Theodor.** Die allgemeine, &c.
141. **MARSH, Mr. Howard.** St. Bartholomew's Hospital Reports, vol. iv.
151. **FLOWER, Professor.** Transactions of the Pathological Society of London, vol. xii.
152. **MALGAIGNE, Dr.** Traité des Fractures et des Luxations, tom. ii.
- 155, 156. **BIGELOW, Professor.** Mechanism of Dislocation and Fracture of the Hip.
156. **PIEBIE, Professor.** Practice of Surgery.
- 157, 158. **BIGELOW, Professor.** Mechanism of Dislocation and Fracture of the Hip.
160. **PIEBIE, Professor.** Practice of Surgery.
164. **PAGET, Sir James.** Lectures on Surgical Pathology.
171. **WILKS and MOXON, Drs.** Pathological Anatomy.
190. **HUMPHRY, Professor.** The Human Skeleton.
191. **HOLMES, Mr.** On the Surgical Treatment of Children's Diseases.

PAGE

191. HEWETT, Mr. Prescott. *Med. Times and Gaz.*, vol. xxxiv.
 208. GEE, Dr. Auscultation and Percussion.
 „ WILKS and MOXON, Drs. *Pathological Anatomy*.
 209. SMITH, Dr. Tyler. *A Manual of Obstetrics*.
 219. SAVORY, Mr. On the Shape of Transverse Wounds of Blood-vessels. Pamphlet, 1859.
 222, 223. CALLENDER, Mr. G. W. Article on Diseases of the Veins, *Holmes's System of Surgery*.
 233, 241, 242. HOLMES, Mr. Article on Aneurism, in *System of Surgery*.
 244, 246. ERICHSEN, Mr. *Science and Art of Surgery*.
 250. CALLENDER, Mr. G. W. Article on Diseases of the Veins, *Holmes's System of Surgery*.
 251. PAGET, Sir James. *Clinical Lectures*, edited by Howard Marsh.
 255, 258. CALLENDER, Mr. G. W. Article on Diseases of the Veins, *Holmes's System of Surgery*.
 259. WILKS and MOXON, Drs. *Pathological Anatomy*.
 276. PAGET, Sir James. *Lectures on Surgical Pathology*.
 290. SALTEE, Mr. Article on Diseases of the Teeth, *Holmes's System of Surgery*.
 291. HEATH, Mr. Christopher. *Injuries and Diseases of the Jaws*.
 311. POLLOCK, Mr. Article on Diseases of the Intestines, *Holmes's System of Surgery*.
 313. ROKITANSKY, Professor. *Pathologische Anatomie*.
 329, 338. BIRKETT, Mr. Article on Hernia. *Holmes's System of Surgery*.
 343. PAGET, Sir James. Clinical Lecture, published in *Med. Times and Gaz.*, 1865.
 343. BRYANT, Mr. *Practice of Surgery*.
 353. BILLROTH, Professor Theodor. *Die allgemeine, &c.*
 361. THOMPSON, Sir Henry. *Stricture of the Urethra, its Pathology and Treatment*.
 376. CURLING, Mr. *A Practical Treatise on the Diseases of the Testes and of the Spermatie Cord and Scrotum*.
 383. PAGET, Sir James. *Medico-Chirurgical Transactions*, vol. xxxiii.
 407. WOLLASTON. *Philosophical Transactions*, 1797.
 420, 425, 428. PAGET, Sir James. *Lectures on Surgical Pathology*.
 420. BIRKETT, Mr. Article on Breast. *Holmes's System of Surgery*.
 428. BUTLIN, Mr. *Medico-Chirurgical Transactions*, vol. lix.

I have also to acknowledge my indebtedness to the authors of the following works :—

Pathological Anatomy, by Jones and Sieveking, edited by Dr. Payne.
An Introduction to Pathology and Morbid Anatomy, by T. Henry Green.
Lehrbuch der pathologischen Gewebelehre, by E. Rindfleisch.
Die Krankhaften Geschwülste, and *Die Cellular Pathologie*, by Rudolf

Virchow. Diseases of the Bones, by Edward Stanley. Practice of Surgery, by T. Bryant. Science and Art of Surgery, by J. E. Erichsen. Observations on Diseases of the Rectum, by T. Blizard Curling. A Text-book of Practical Medicine, by F. Niemeyer, translated by Drs. Humphreys and Hackley.

ERRATA.

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- Page 15, line 32.—*For found, read formed.*
" 20, " 12.— " lower, *read* upper.
" 46, " 81.— " cord, *read* chord.
" 91, " 27.— " Subseries 142, *read* Subseries C. 142.
" 186, " 5.— " vertebra, *read* vertebræ.
" 204, " 26.— " 84, *read* 85.
" 214, lines 15 and 18.—*For* spinal, *read* spiral.
" 266, line 41.—*For* anterior, *read* posterior.
" 282, " 19.— " 138, *read* 338.
" 333, " 37.— " XVI, *read* XVII.
" 344, " 7.— " XVII, *read* XVI.

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